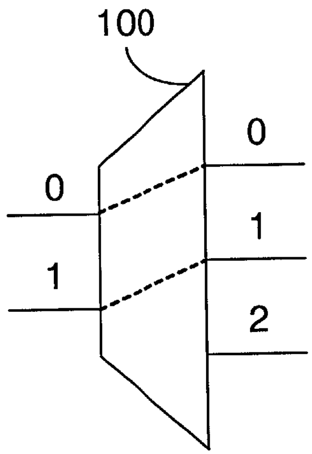


FIG. 1A

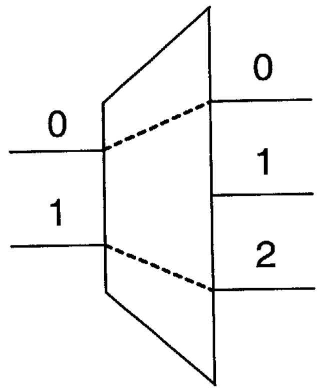


FIG. 1B

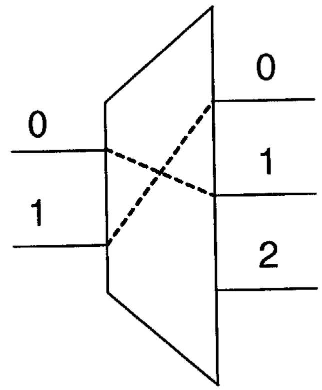


FIG. 1C

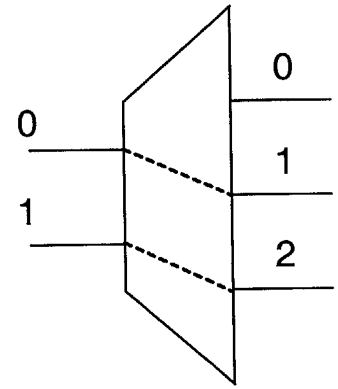


FIG. 1D

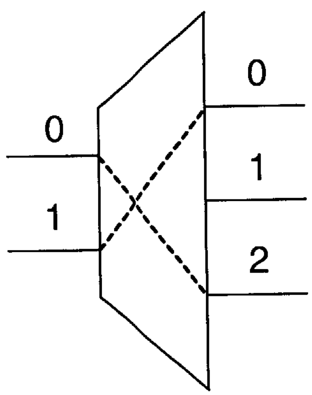


FIG. 1E

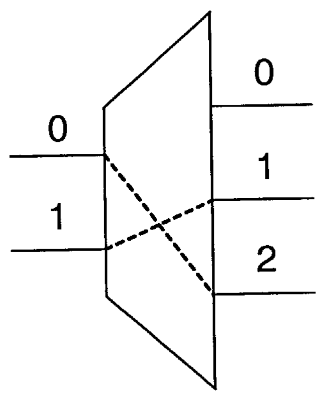


FIG. 1F

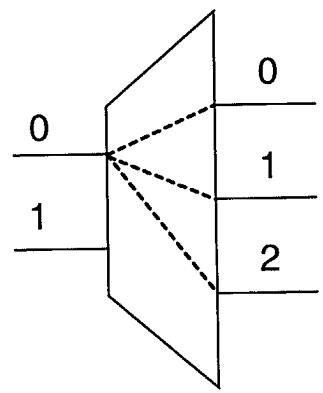


FIG. 1G

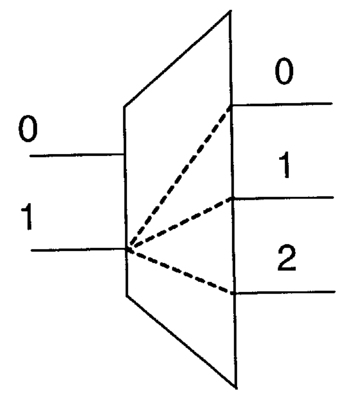


FIG. 1H

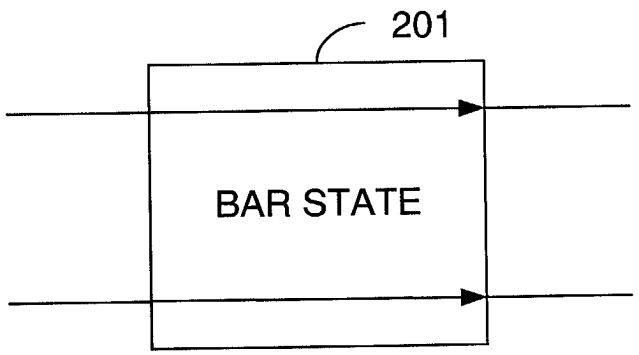


FIG. 2A

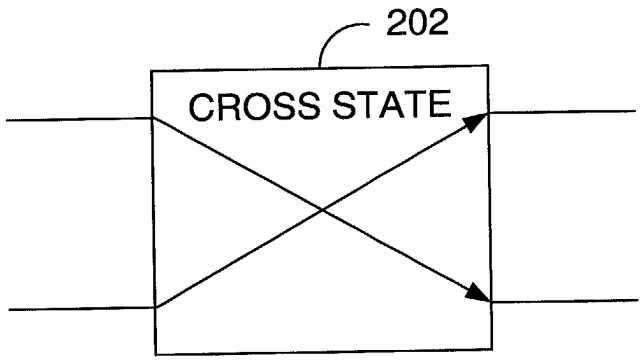


FIG. 2B

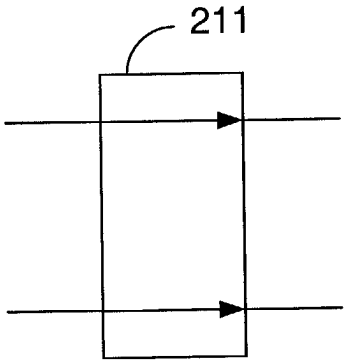


FIG. 2C

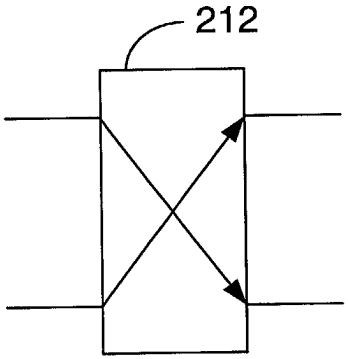


FIG. 2D

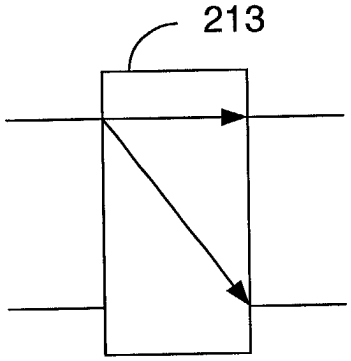


FIG. 2E

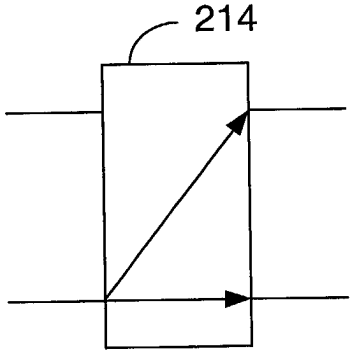


FIG. 2F

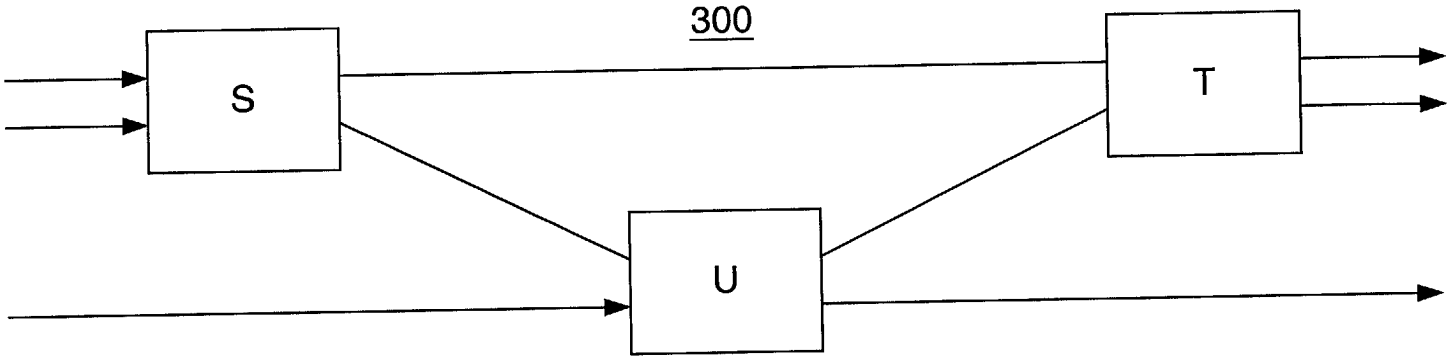


FIG. 3A

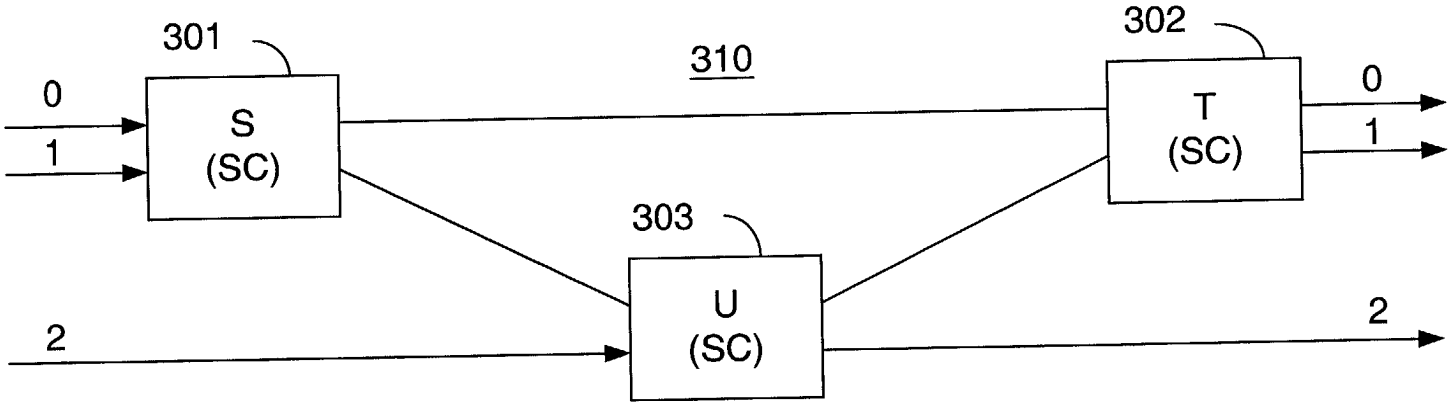


FIG. 3B

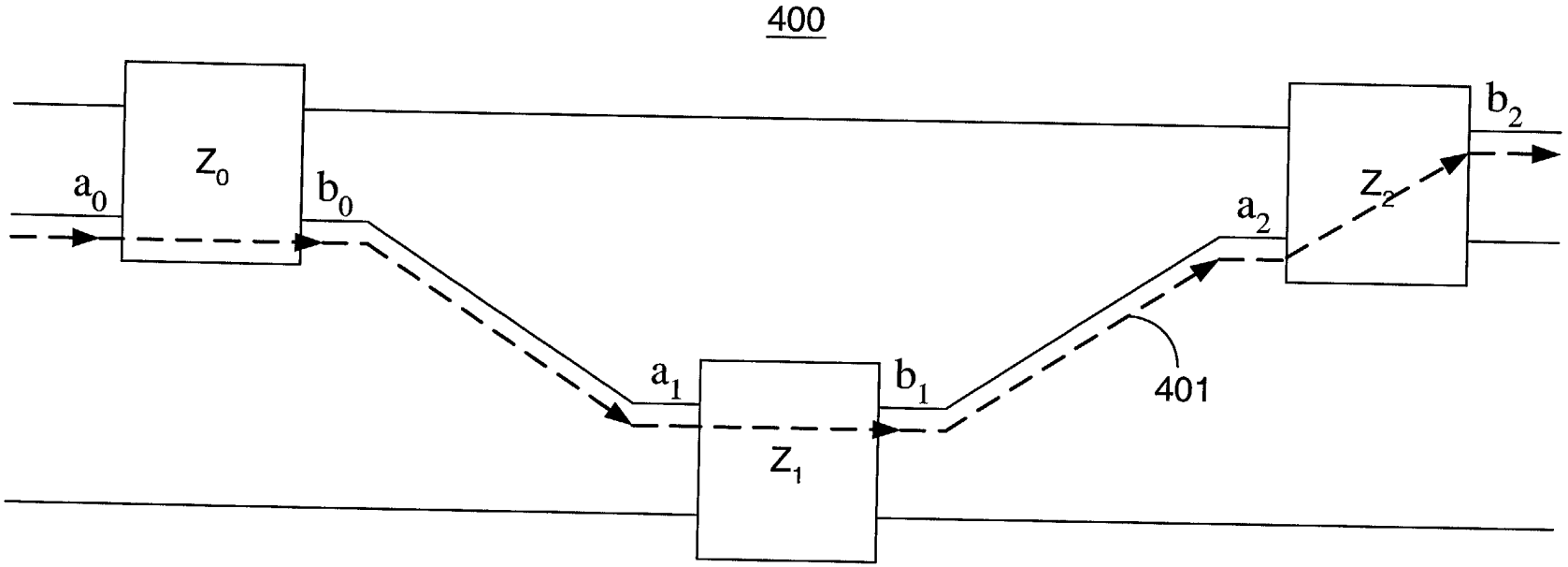


FIG. 4

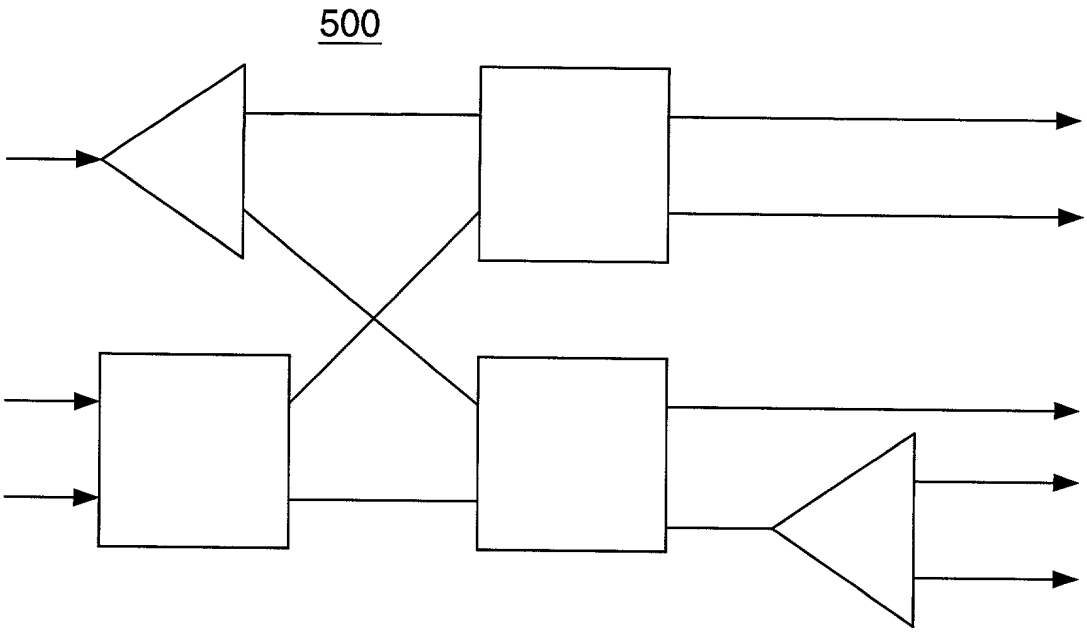


FIG. 5A

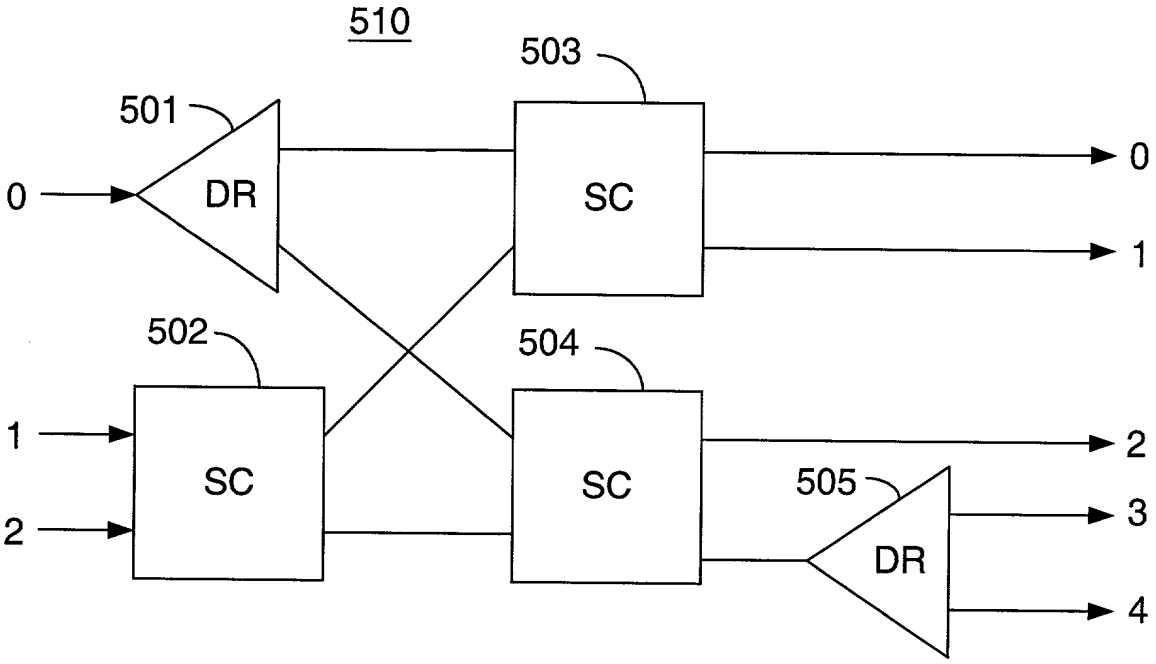


FIG. 5B

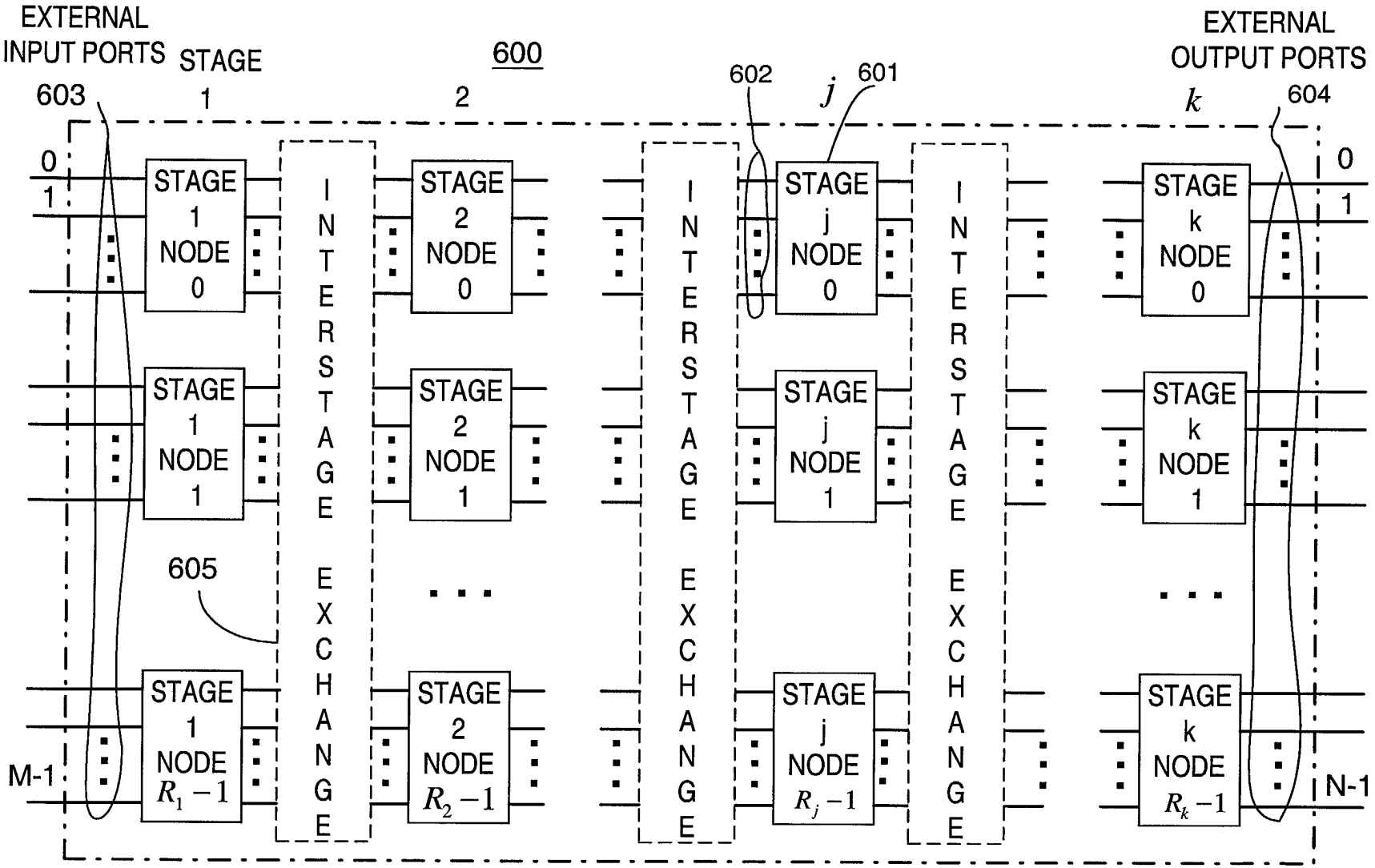


FIG. 6A

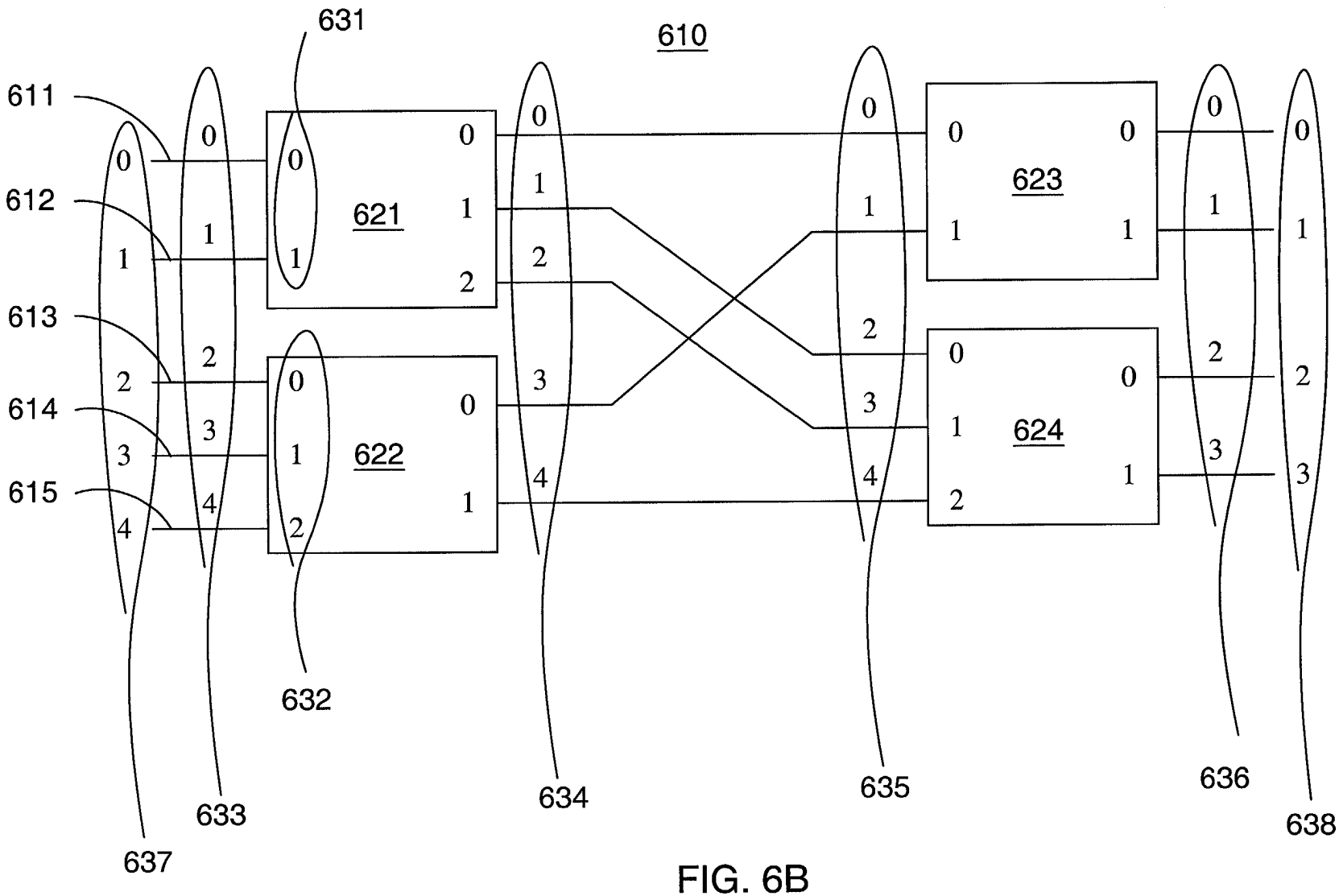


FIG. 6B

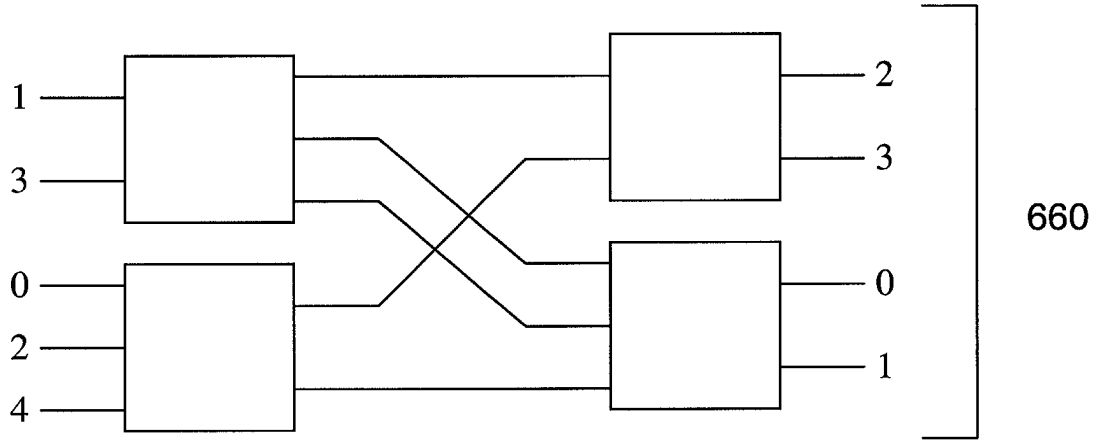

1
3
0
2
4
2
3
0
1
660

FIG. 6C

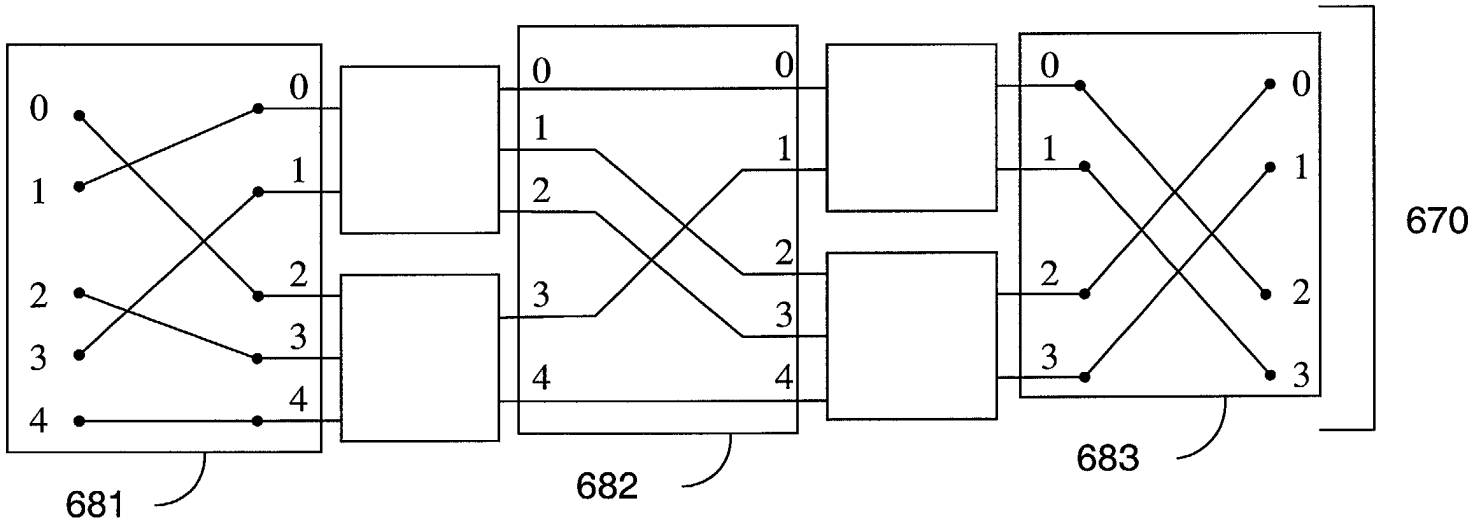

0
1
2
3
4
0
1
2
3
4
681
0
1
2
3
4
0
1
2
3
4
682
0
1
2
3
0
1
2
3
683
0
1
2
3
670

FIG. 6D

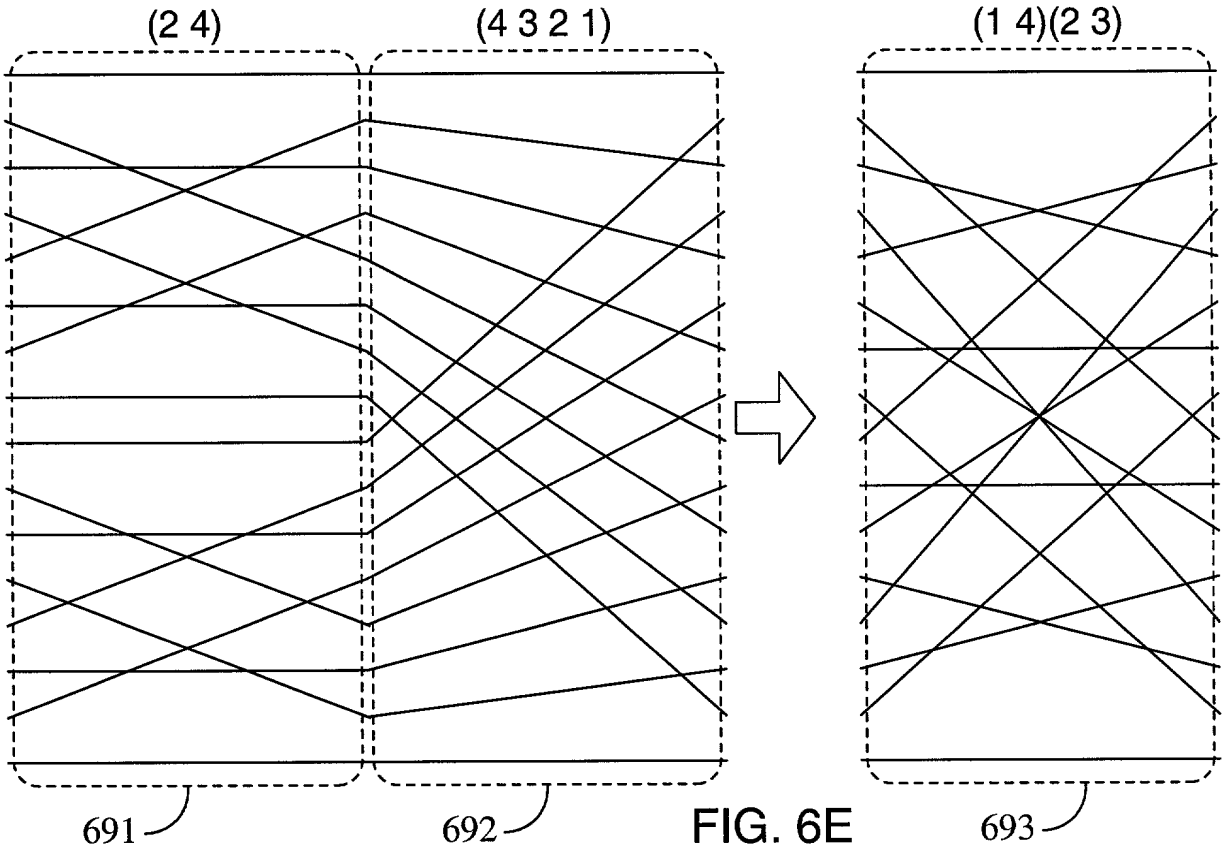


FIG. 6E

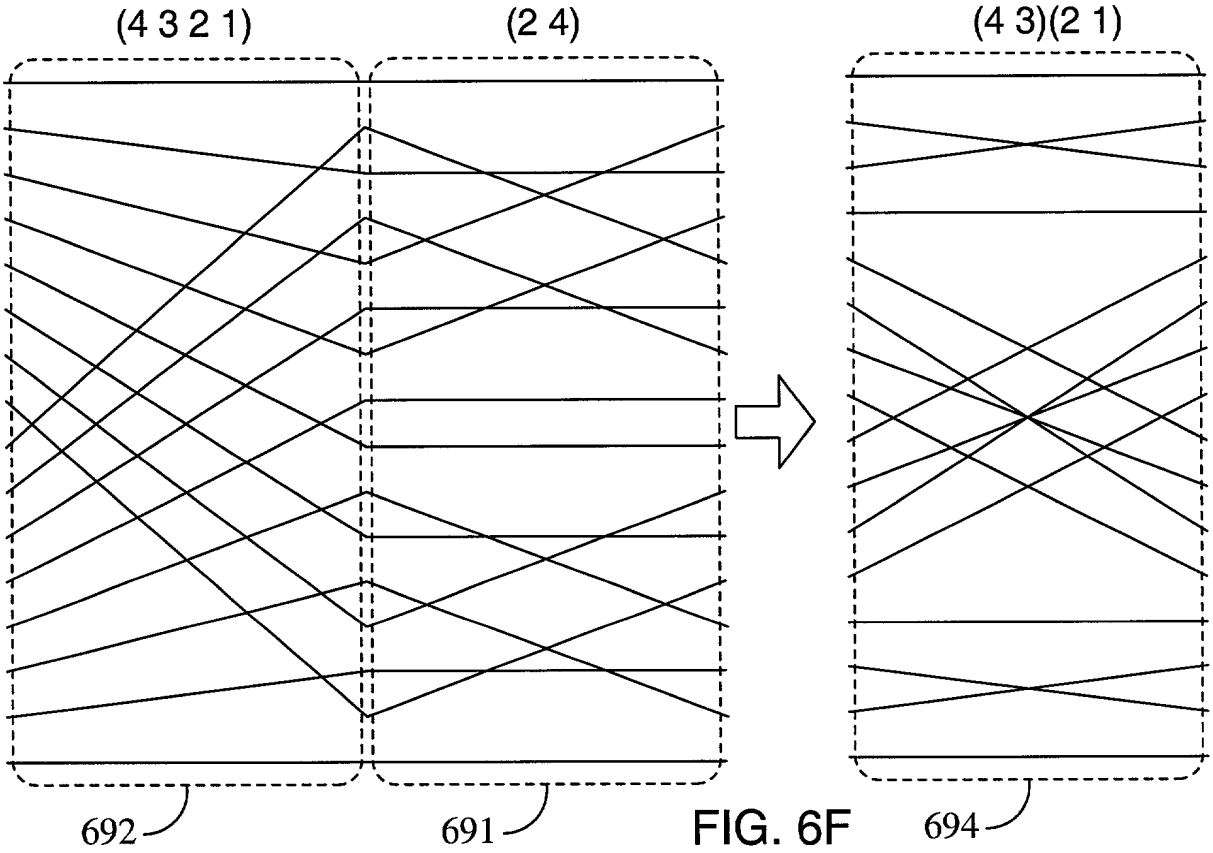


FIG. 6F

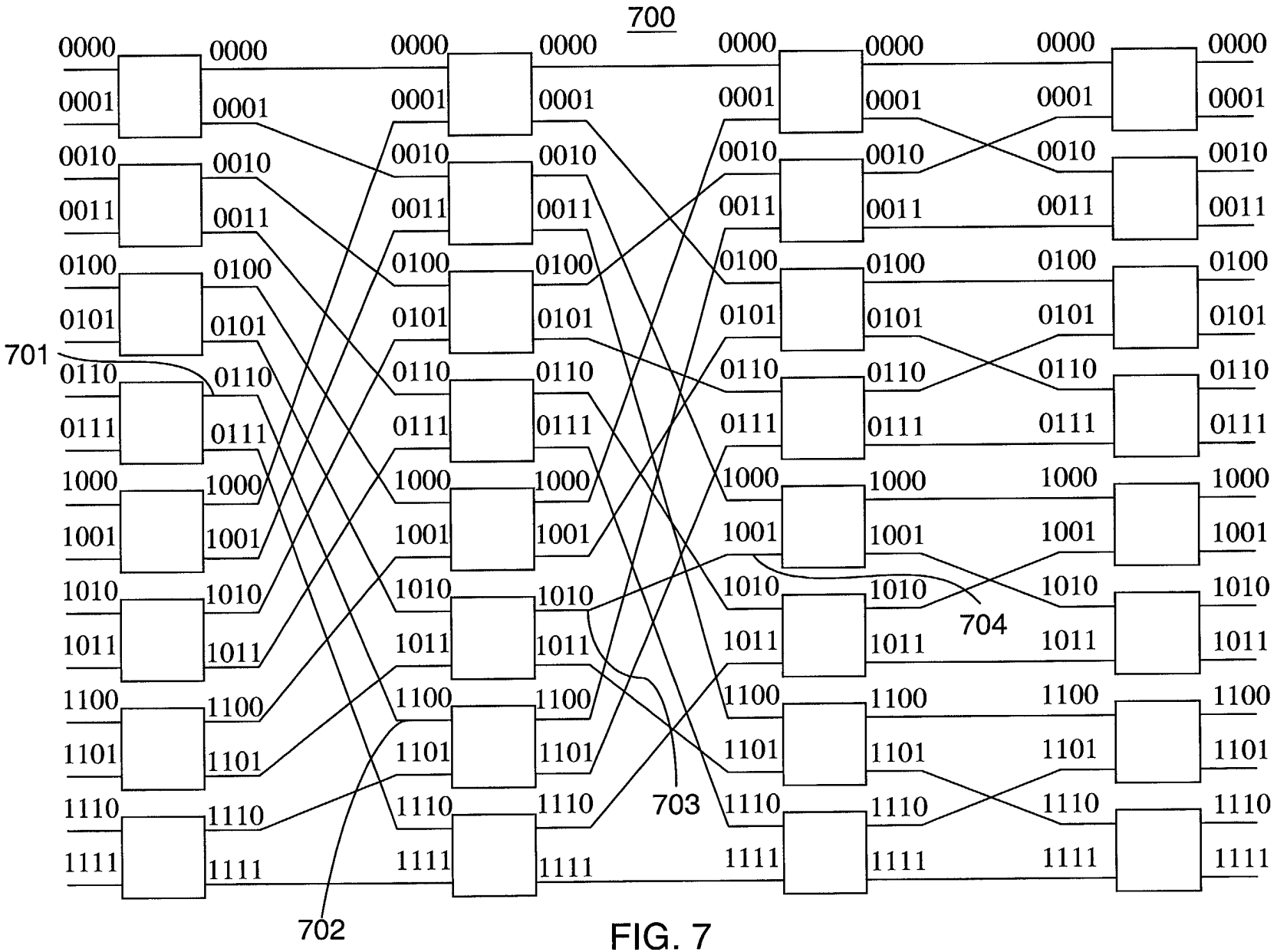


FIG. 7

800

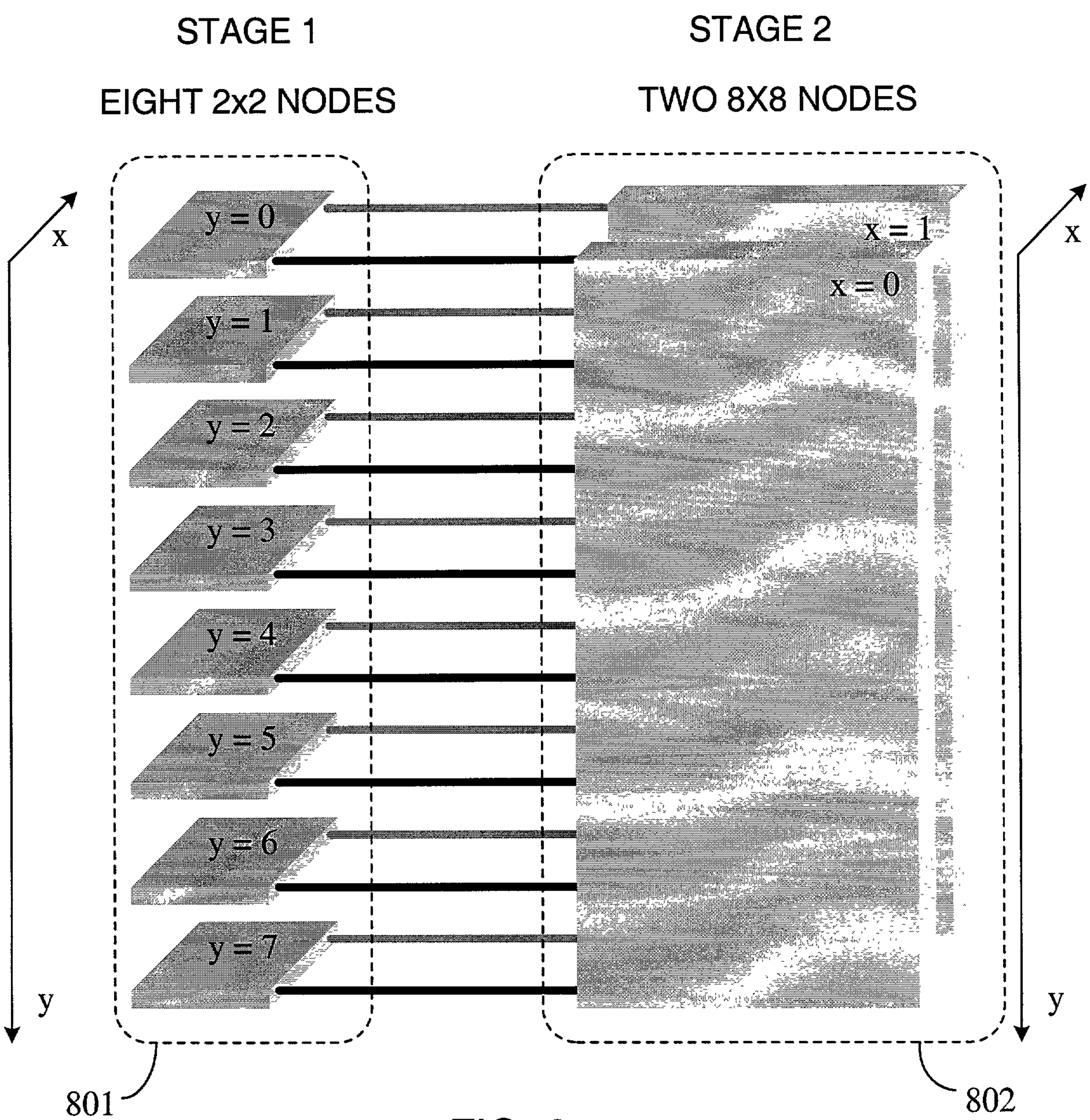

STAGE 1
EIGHT 2x2 NODES
STAGE 2
TWO 8X8 NODES
y = 0
y = 1
y = 2
y = 3
y = 4
y = 5
y = 6
y = 7
x = 1
x = 0
x
y
x
y
801
802

FIG. 8

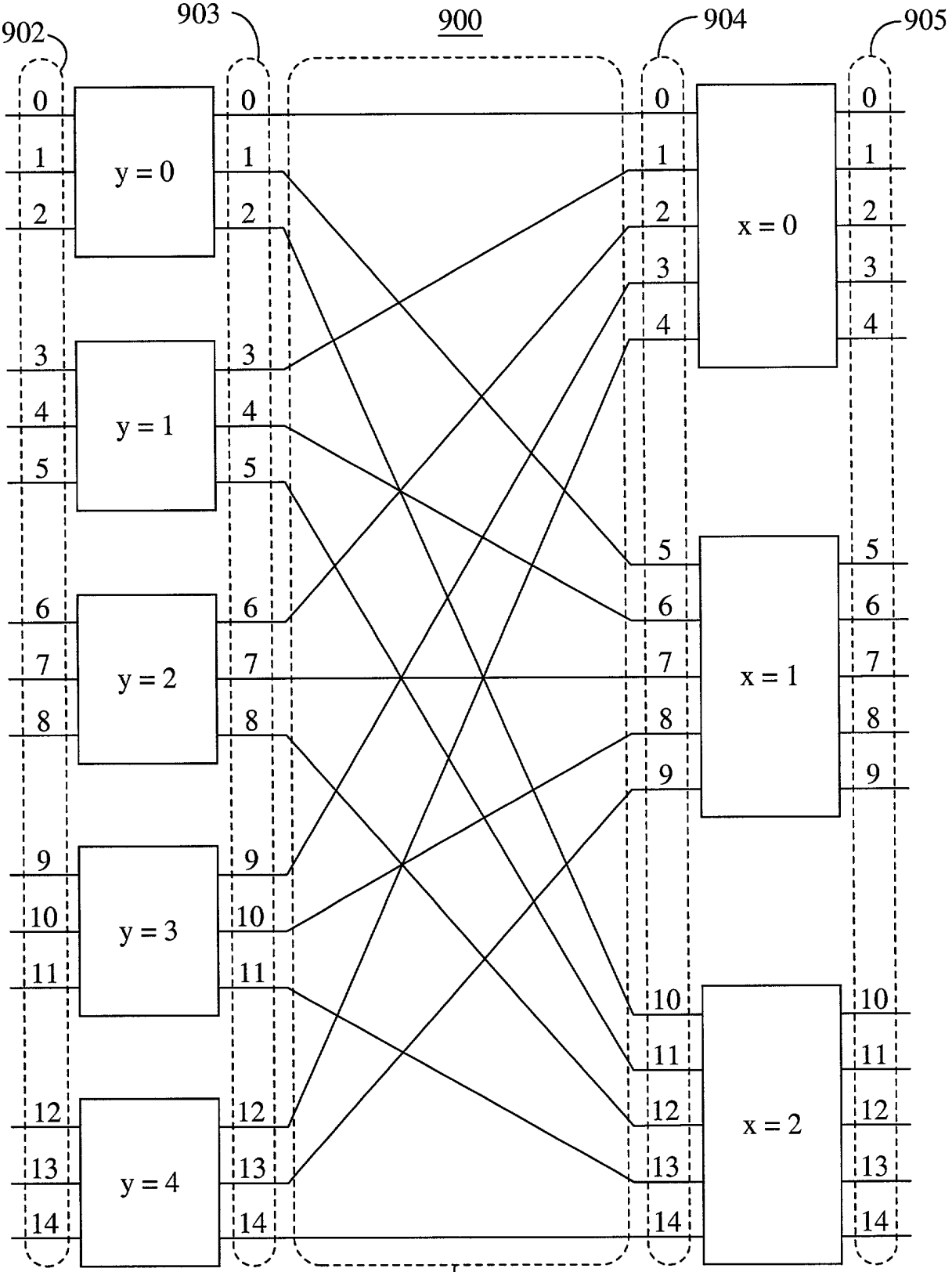

902
903
900
904
905
y = 0
y = 1
y = 2
y = 3
y = 4
x = 0
x = 1
x = 2
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
901

FIG. 9

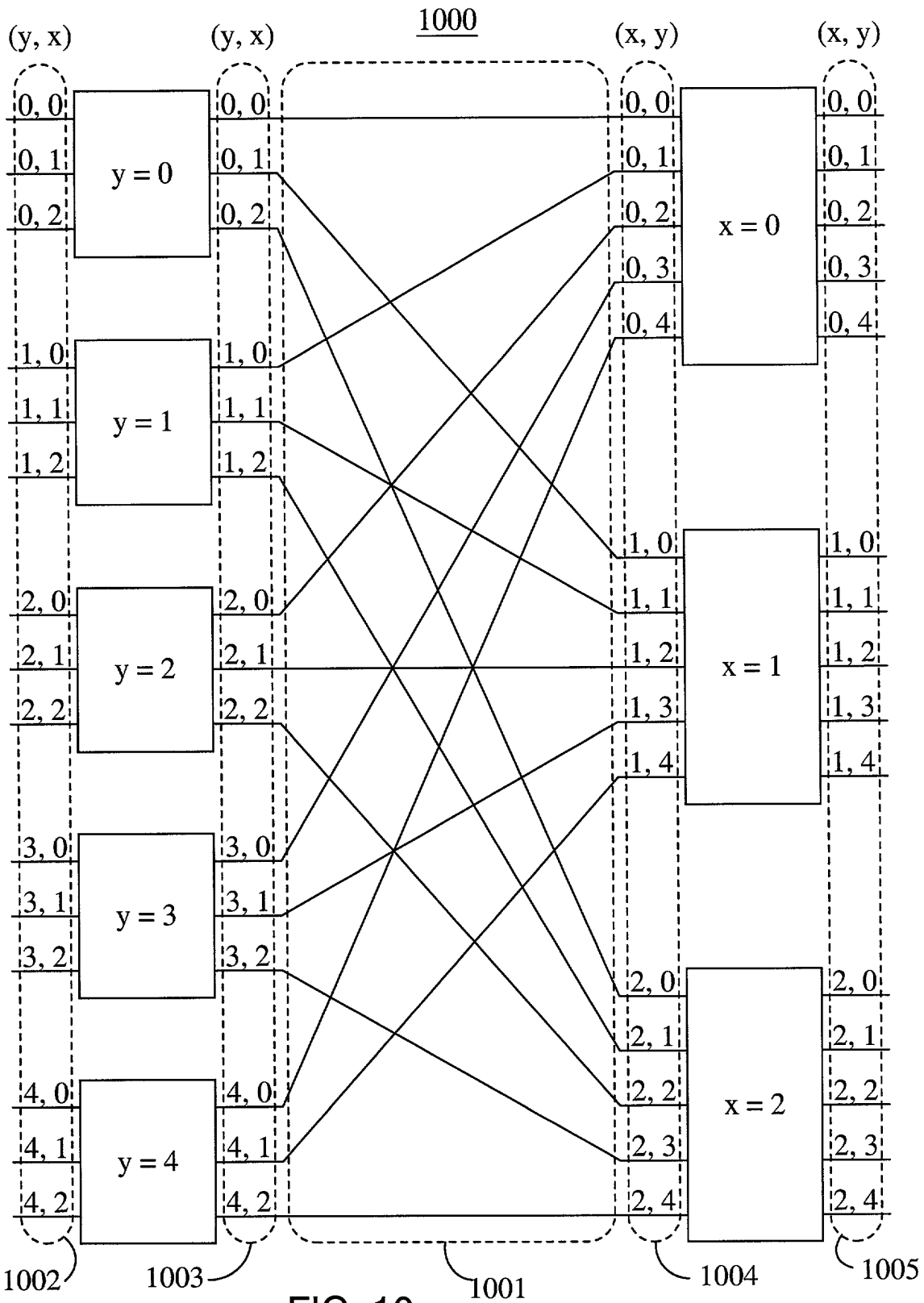

1000
(y, x)
(y, x)
(x, y)
(x, y)
0, 0
0, 1
0, 2
y = 0
1, 0
1, 1
1, 2
y = 1
2, 0
2, 1
2, 2
y = 2
3, 0
3, 1
3, 2
y = 3
4, 0
4, 1
4, 2
y = 4
0, 3
0, 4
x = 0
1, 3
1, 4
x = 1
2, 3
2, 4
x = 2
1002
1003
1001
1004
1005

FIG. 10

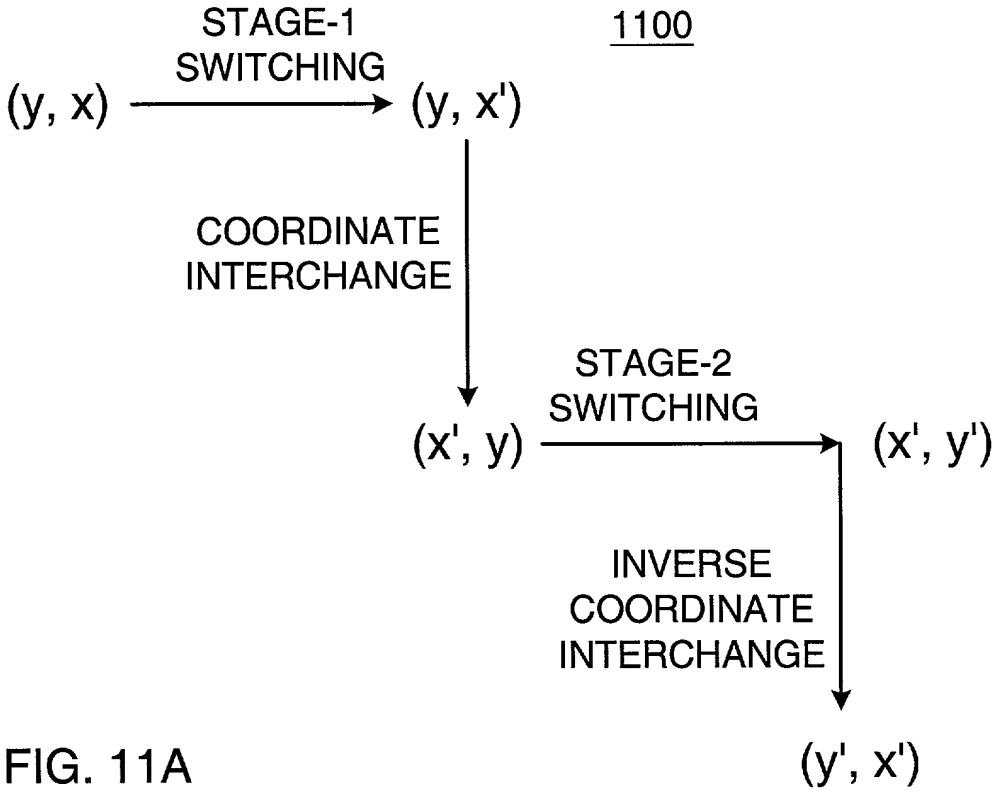


FIG. 11A

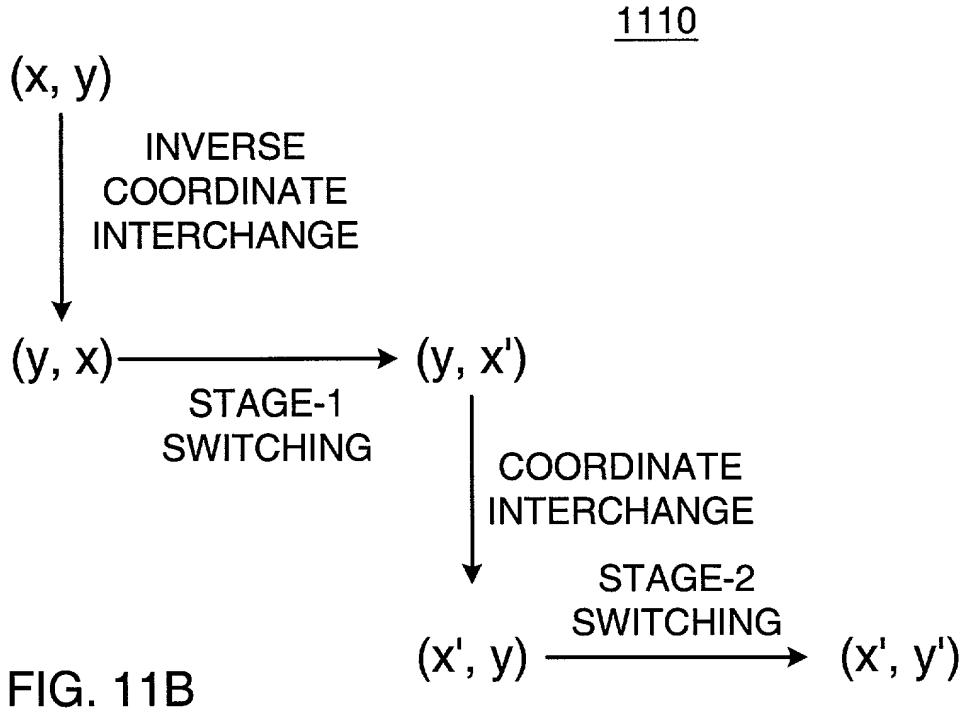


FIG. 11B

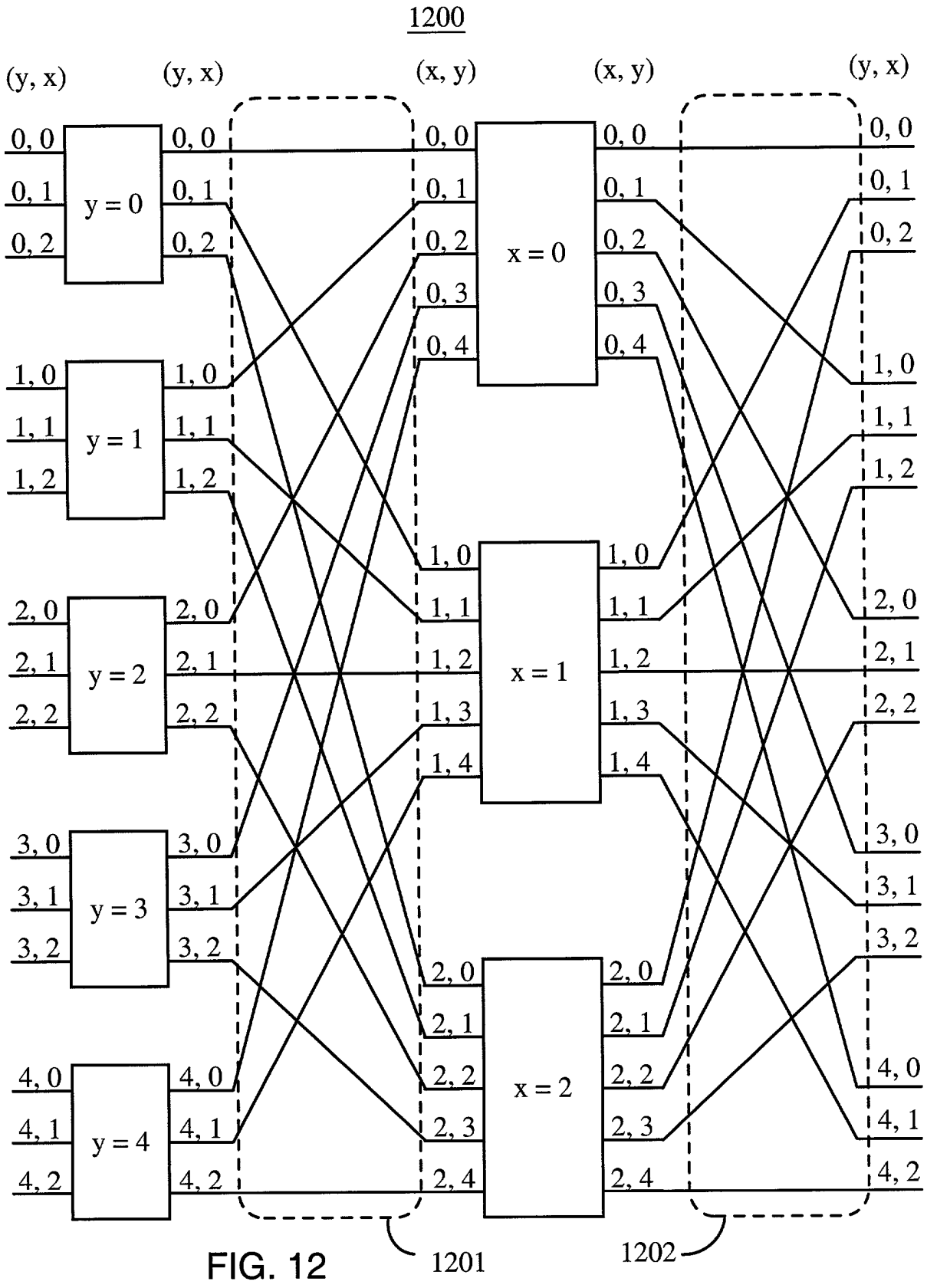

1200
(y, x)
(y, x)
(x, y)
(x, y)
(y, x)
0, 0
0, 1
0, 2
y = 0
1, 0
1, 1
1, 2
y = 1
2, 0
2, 1
2, 2
y = 2
3, 0
3, 1
3, 2
y = 3
4, 0
4, 1
4, 2
y = 4
x = 0
x = 1
x = 2
1201
1202

FIG. 12

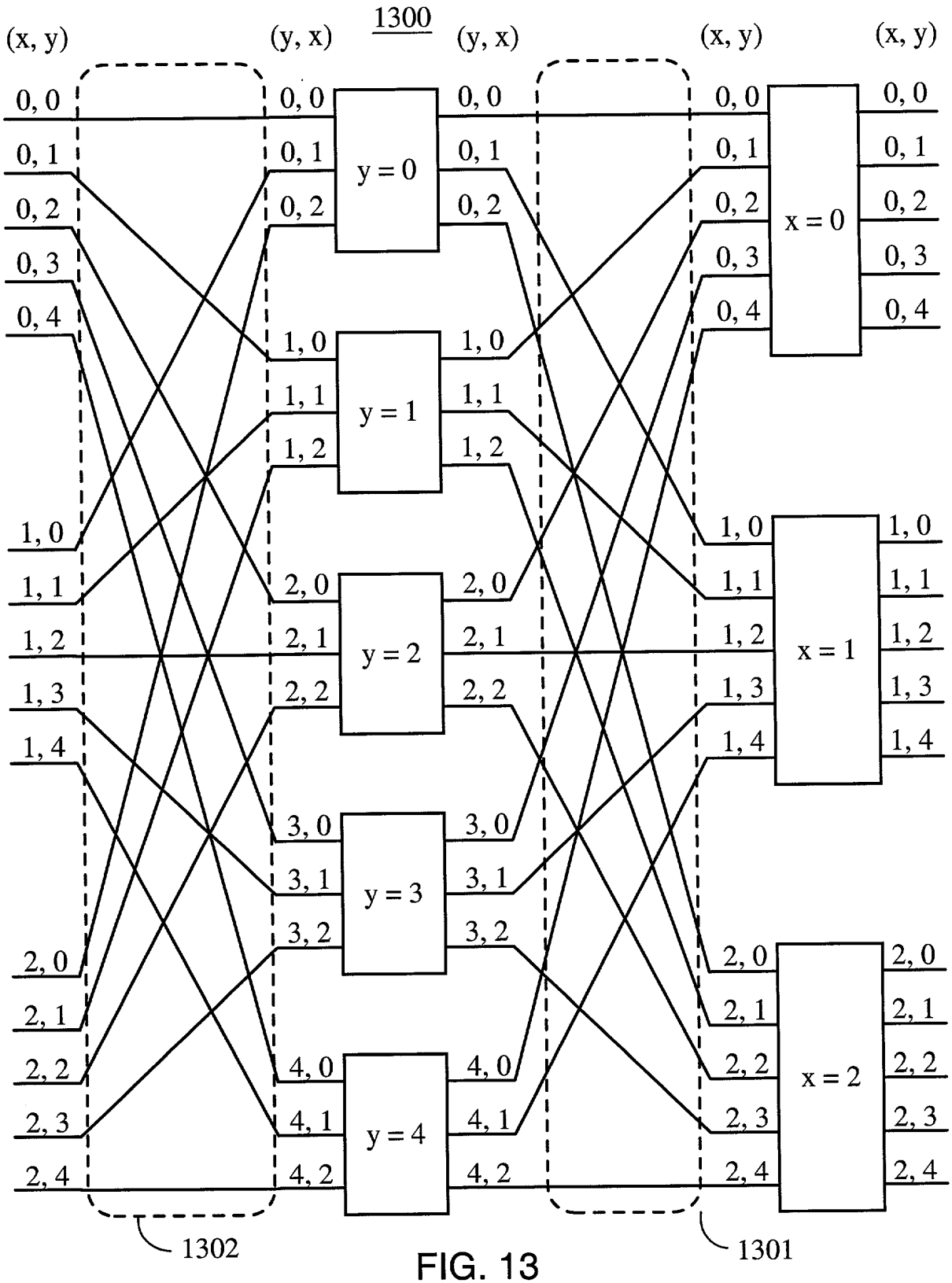

1300
(x, y)
(y, x)
(y, x)
(x, y)
(x, y)
0, 0
0, 1
0, 2
0, 3
0, 4
1, 0
1, 1
1, 2
1, 3
1, 4
2, 0
2, 1
2, 2
2, 3
2, 4
y = 0
y = 1
y = 2
y = 3
y = 4
x = 0
x = 1
x = 2
1302
1301

FIG. 13

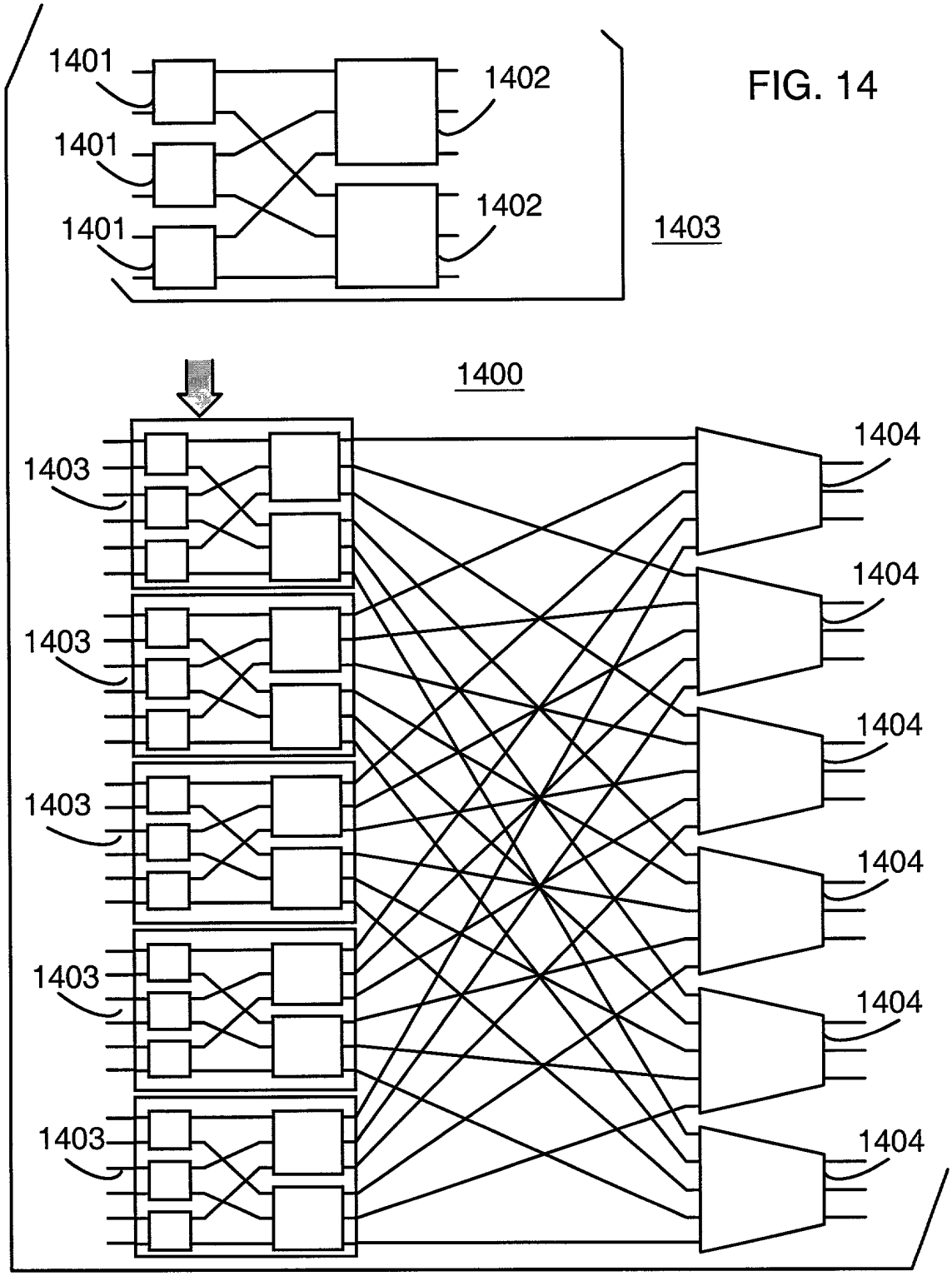

1401
1401
1401
1402
1402
1403
1400
1403
1403
1403
1403
1403
1404
1404
1404
1404
1404
1404

FIG. 14

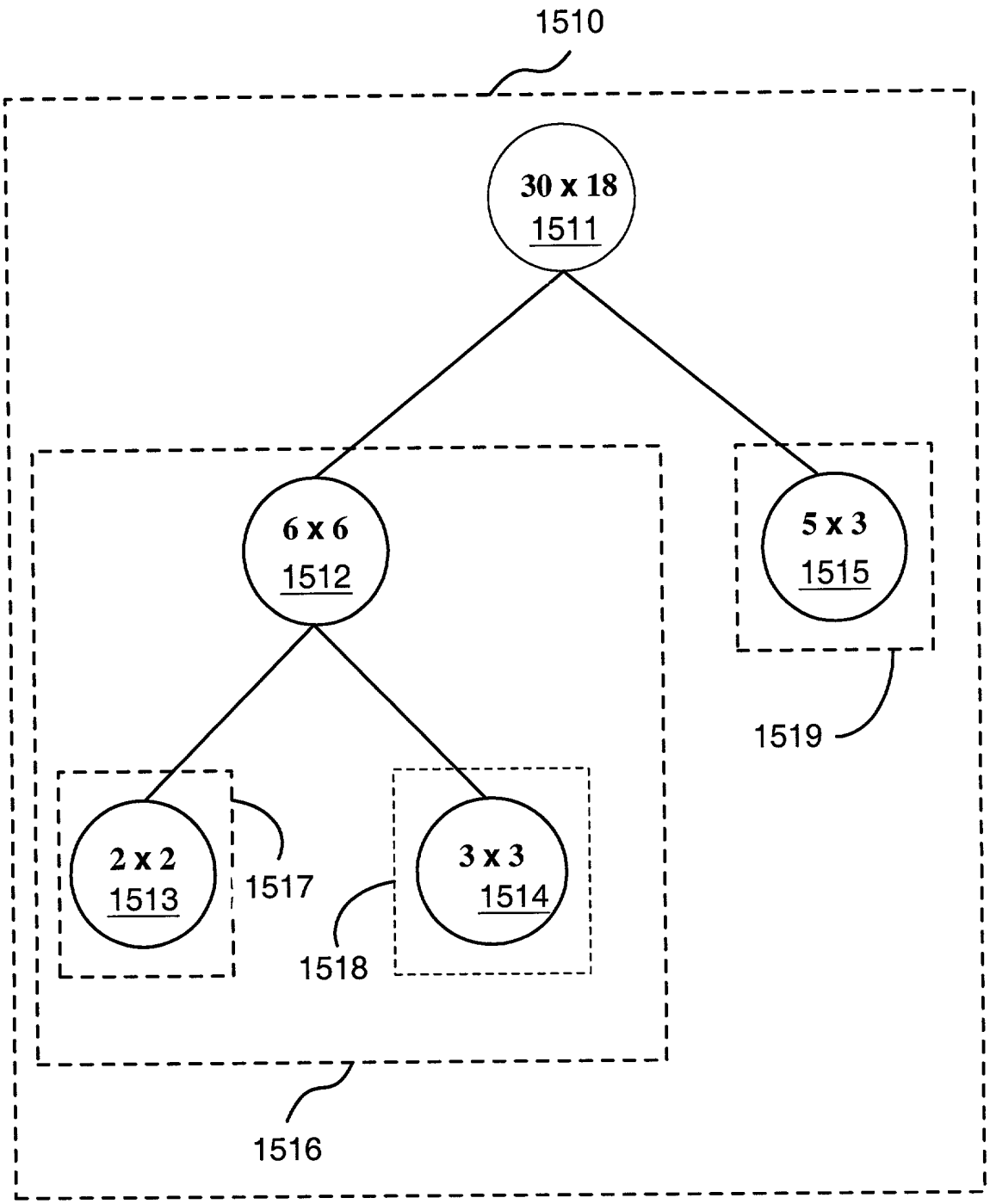

1510
30 x 18
1511
6 x 6
1512
5 x 3
1515
1519
2 x 2
1513
1517
3 x 3
1514
1518
1516

FIG. 15

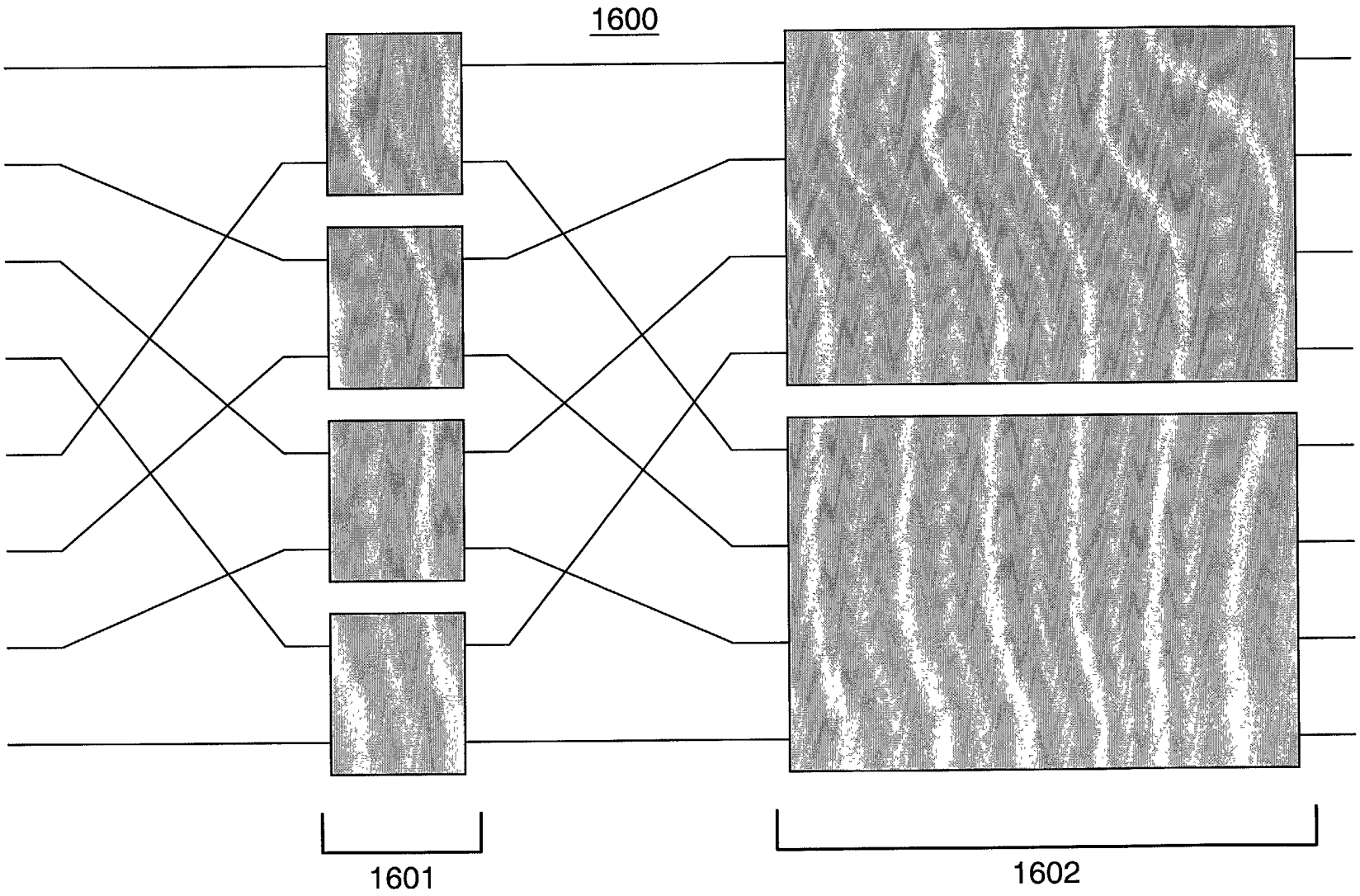


FIG. 16

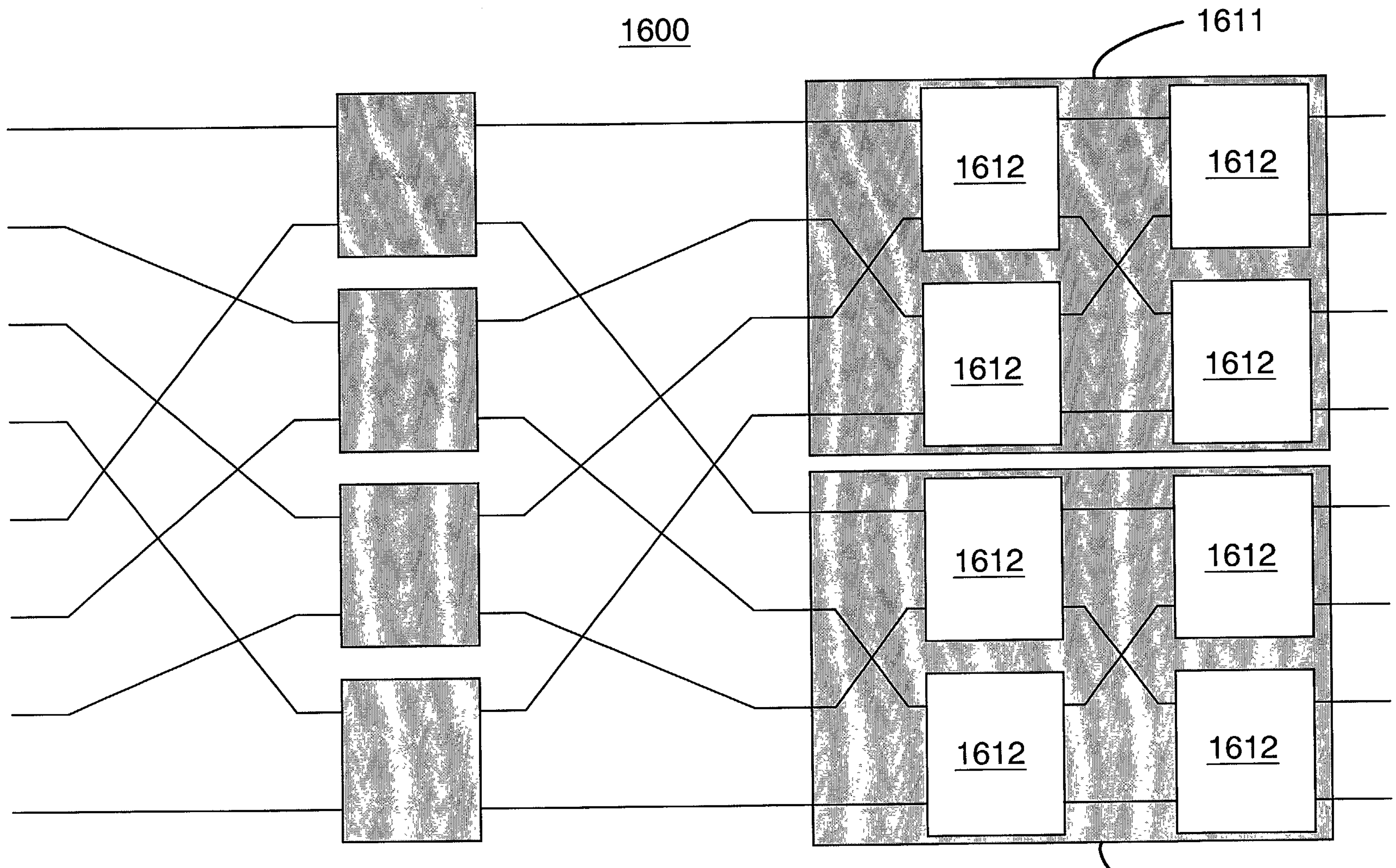


FIG. 17

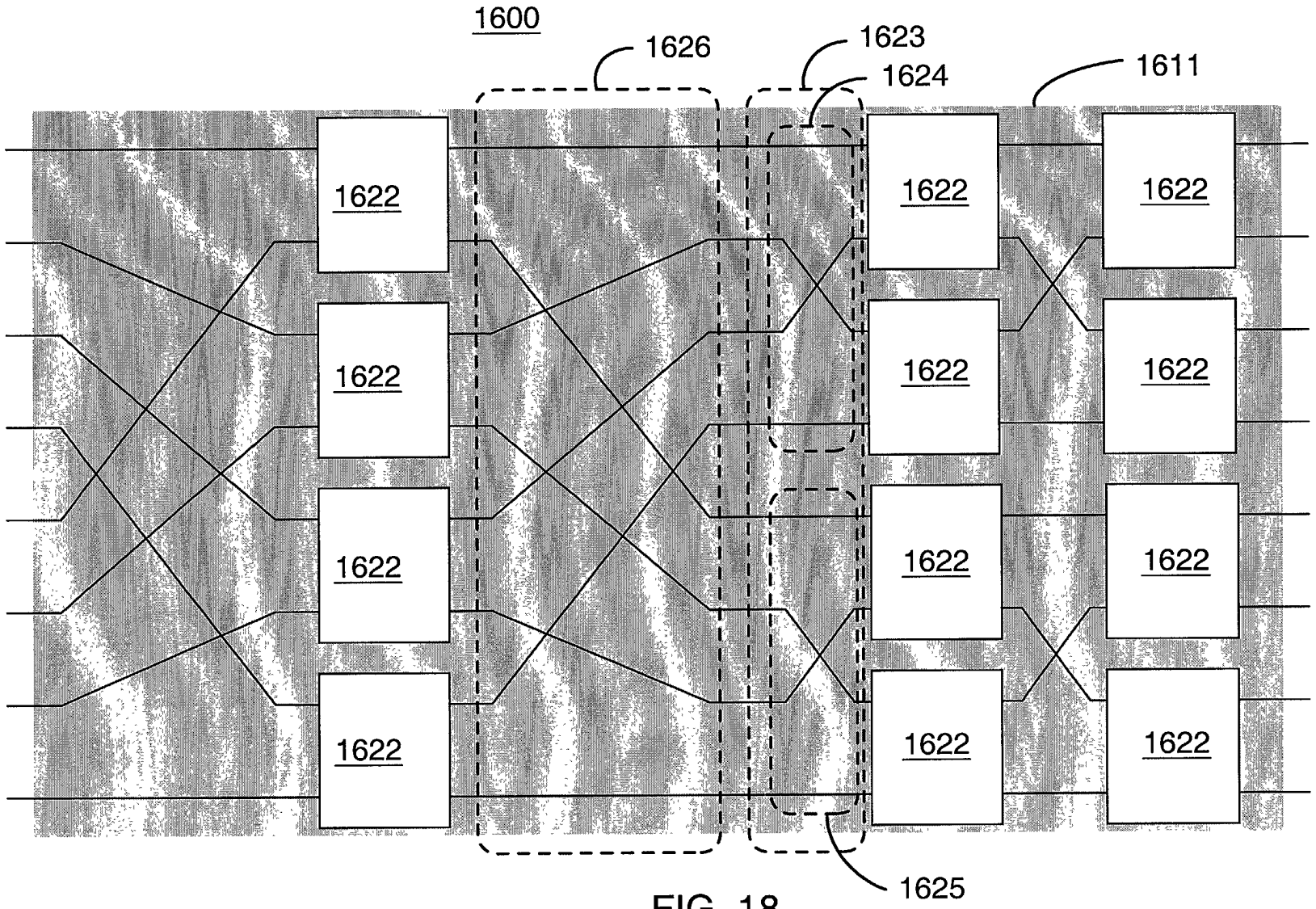

1600
1626
1623
1624
1611
1622
1622
1622
1622
1622
1622
1622
1622
1622
1622
1625

FIG. 18

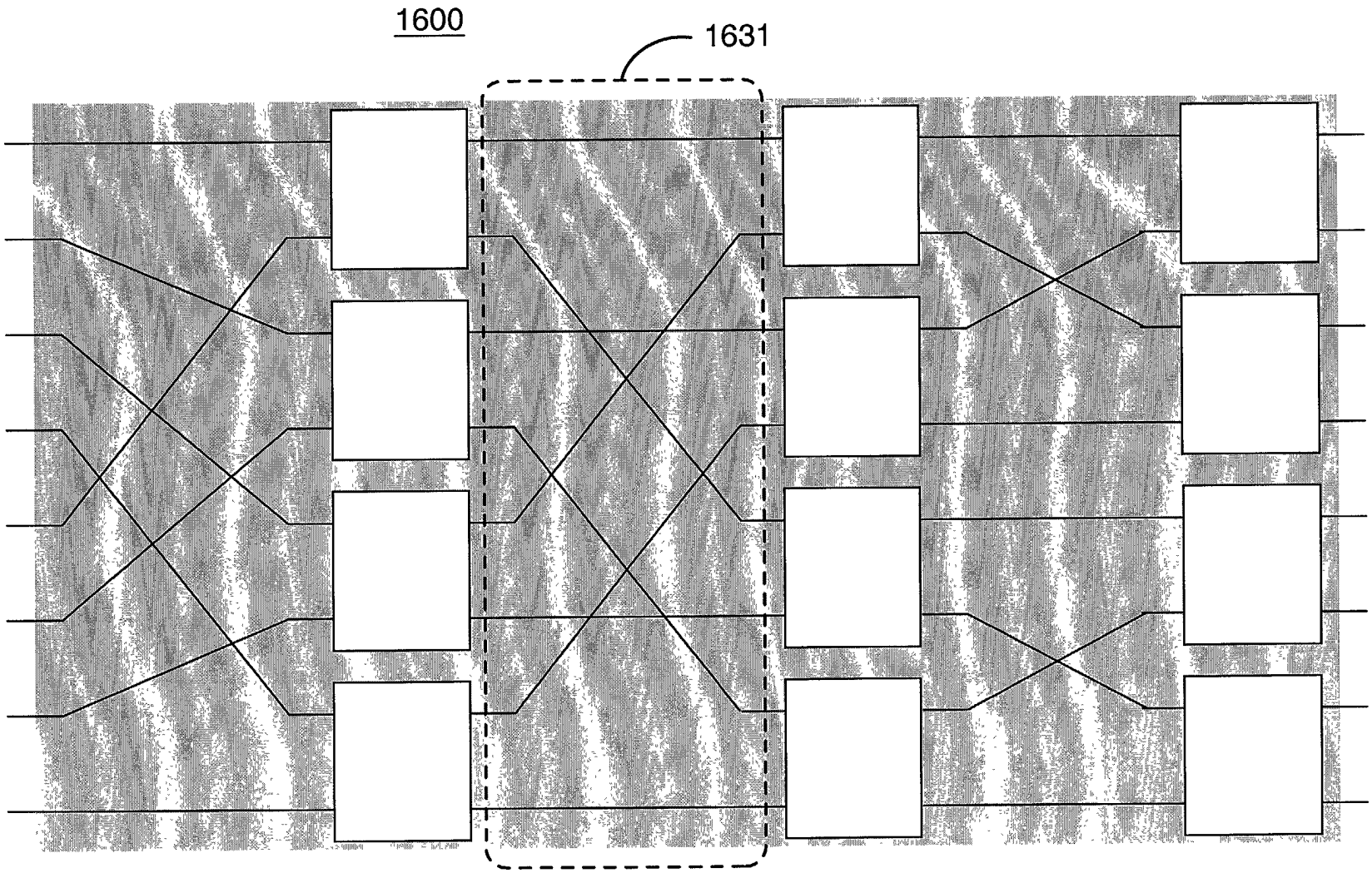


FIG. 19

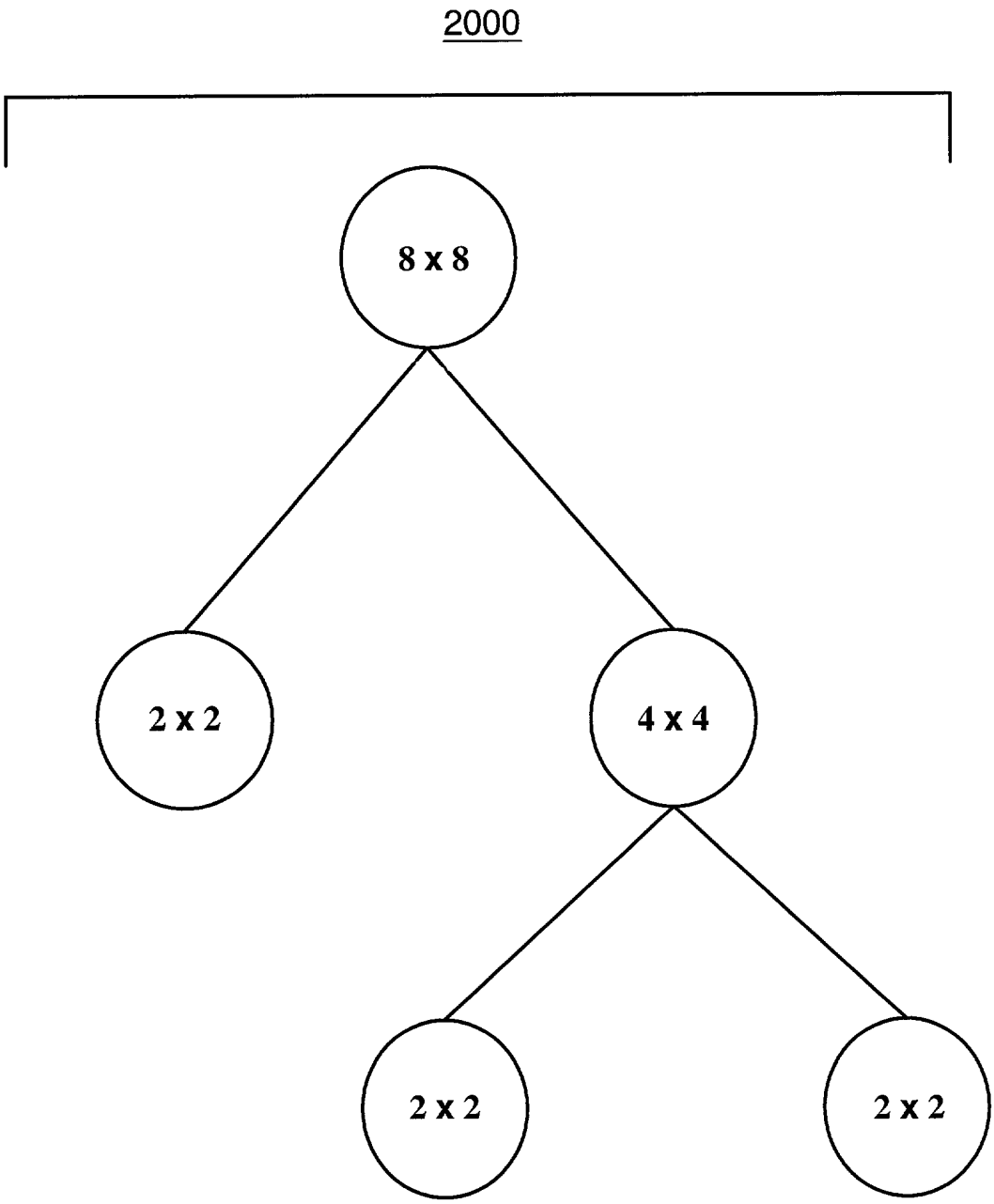


FIG. 20

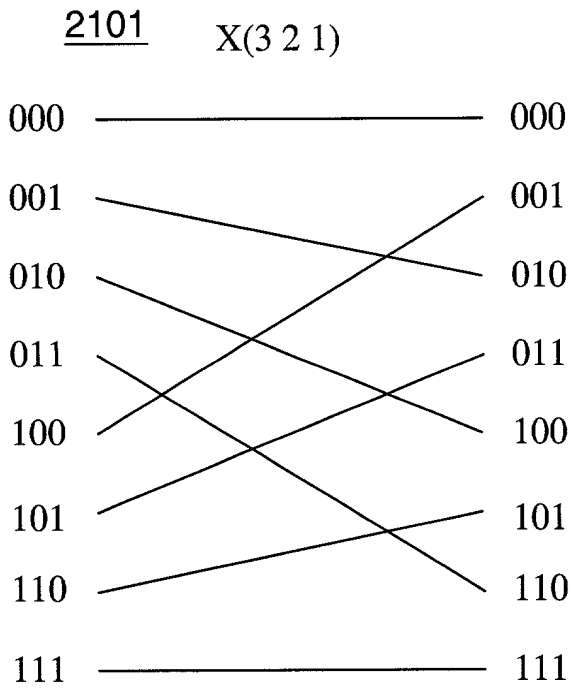


FIG. 21A

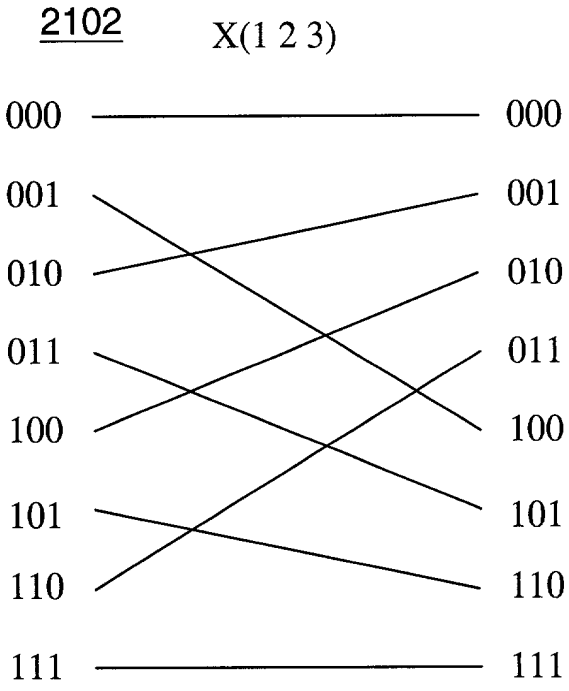


FIG. 21B

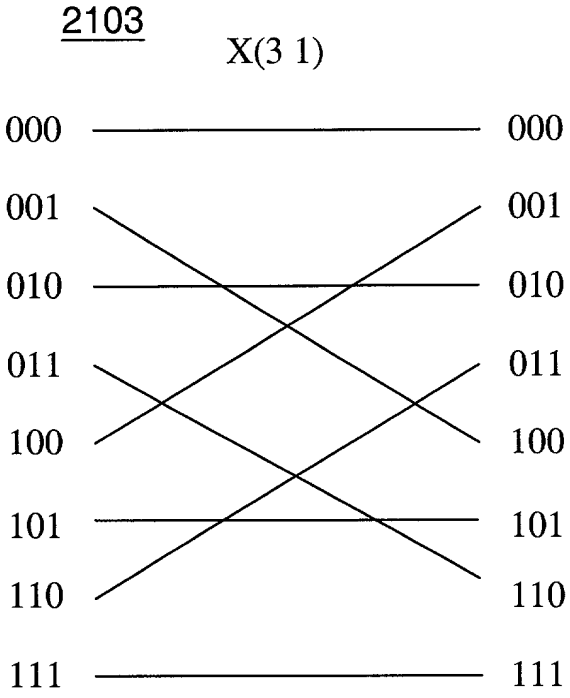


FIG. 21C

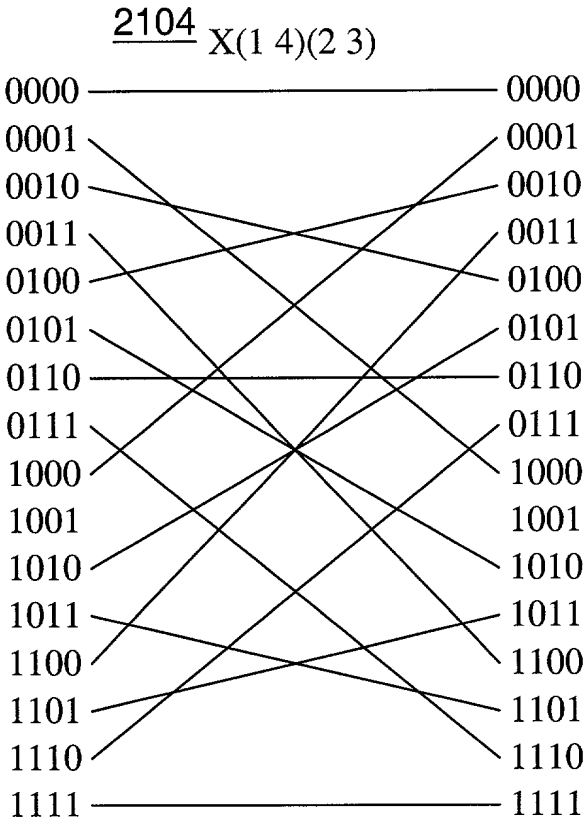
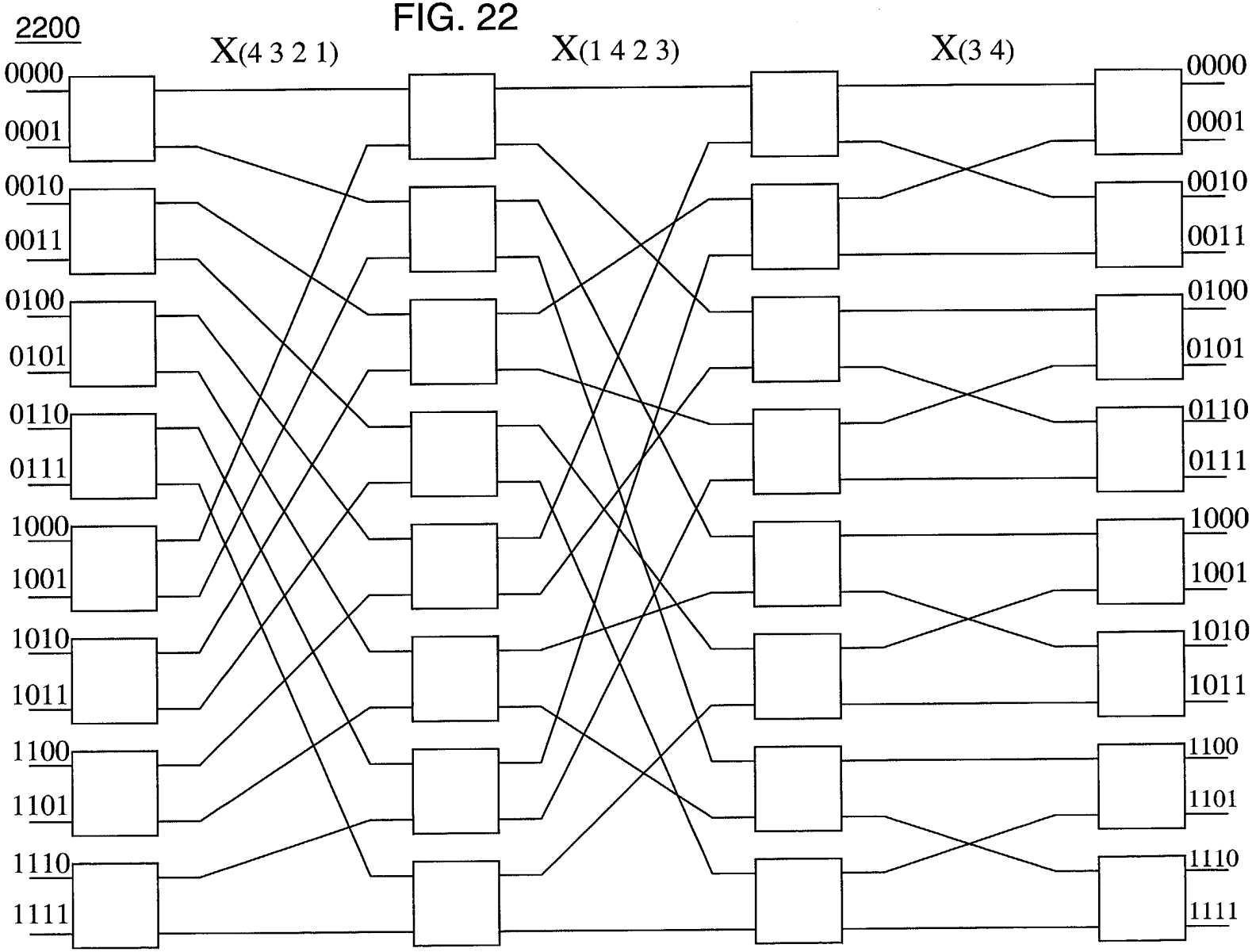


FIG. 21D

FIG. 22



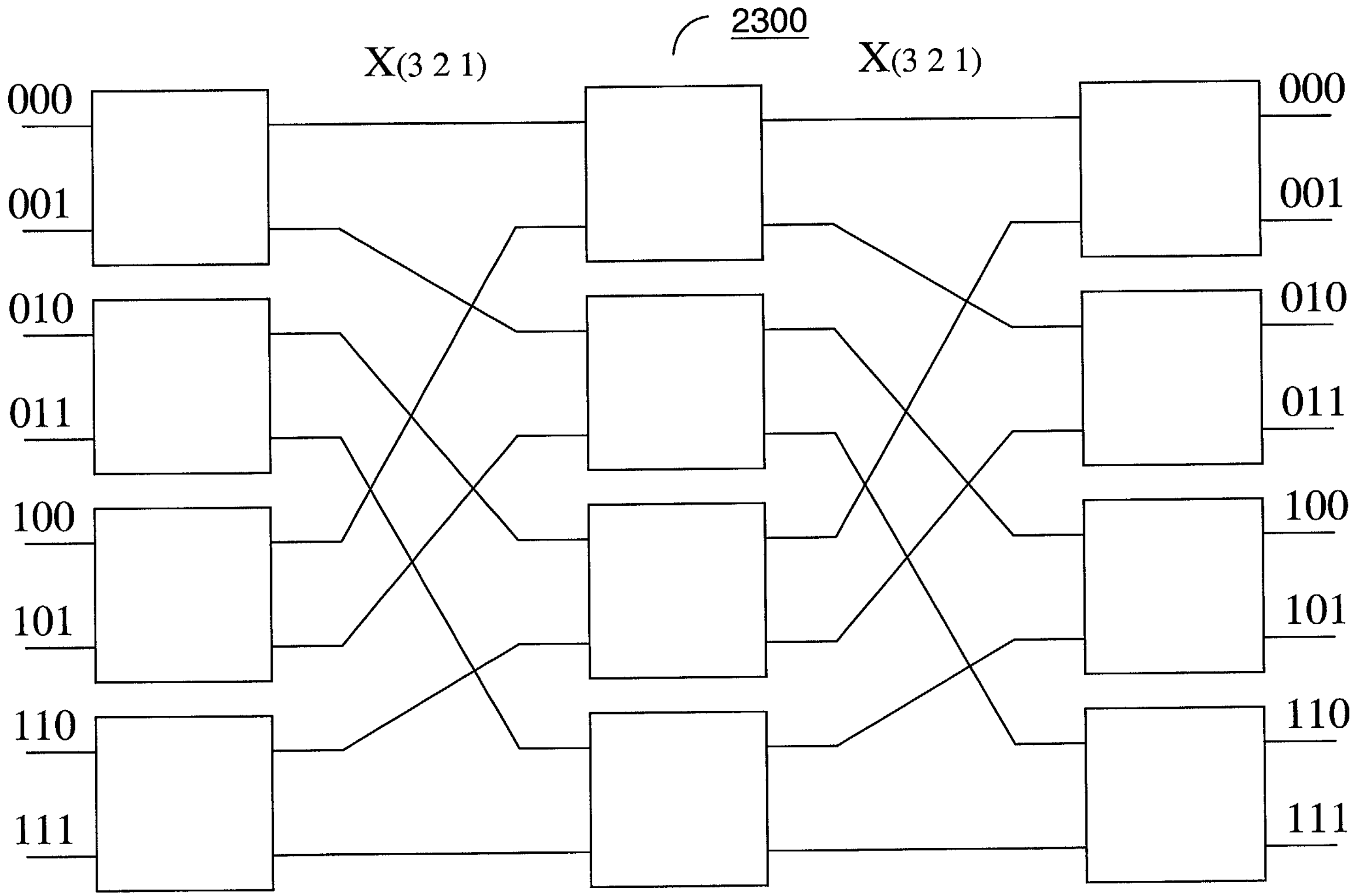

2300
X(3 2 1)
X(3 2 1)
000
001
010
011
100
101
110
111
000
001
010
011
100
101
110
111

FIG. 23

2400

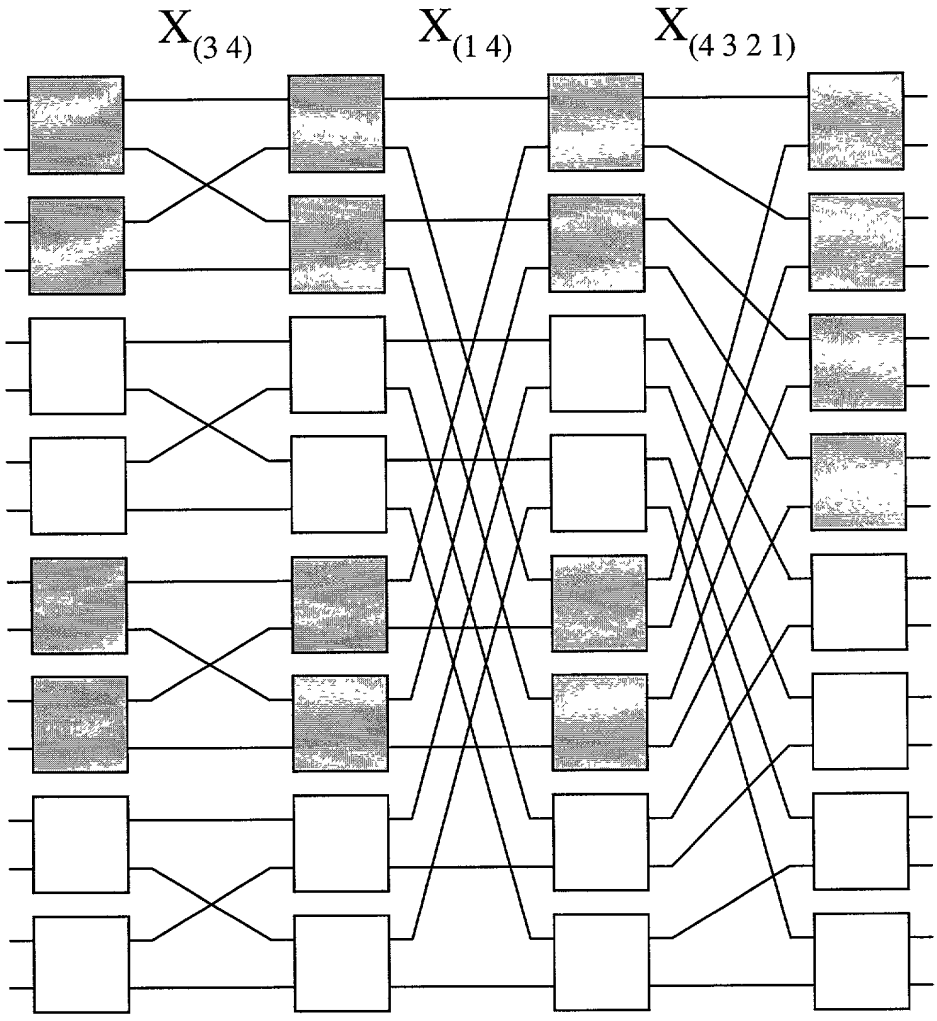


FIG. 24

FIG. 25

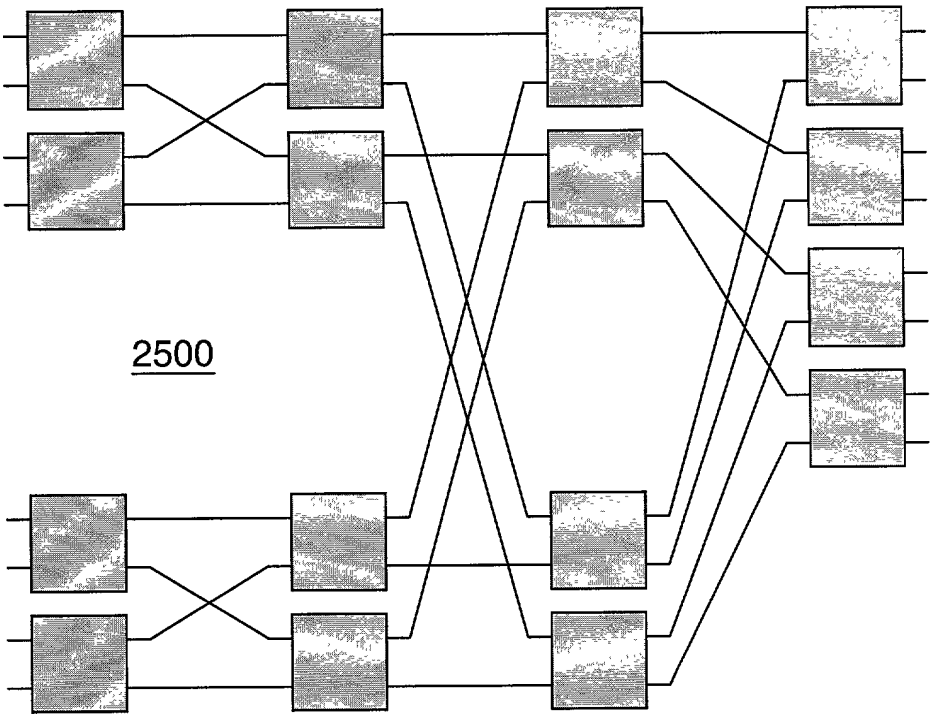
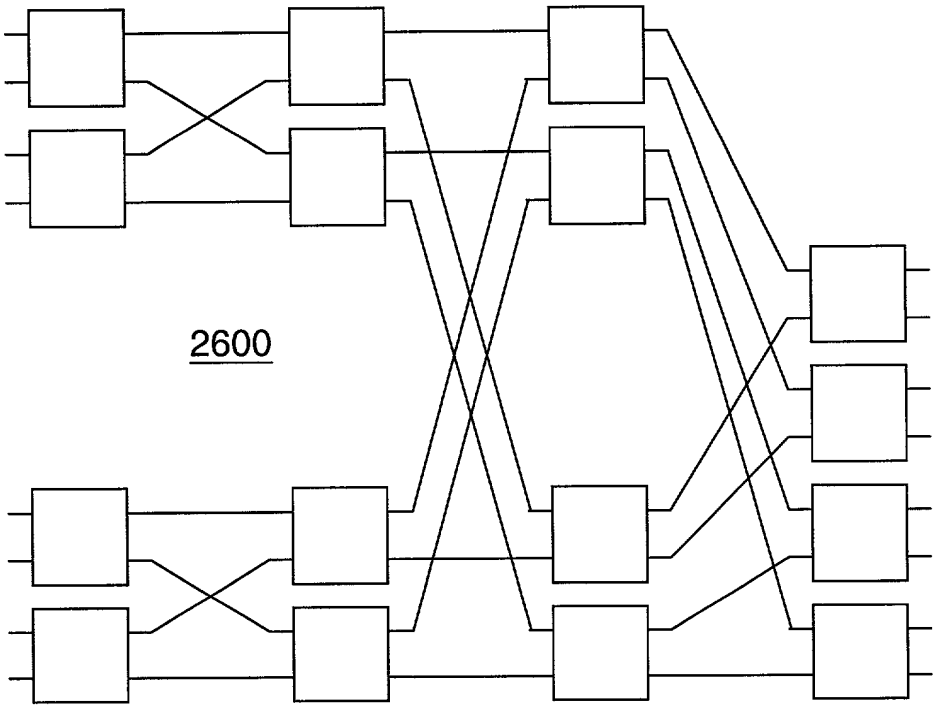


FIG. 26



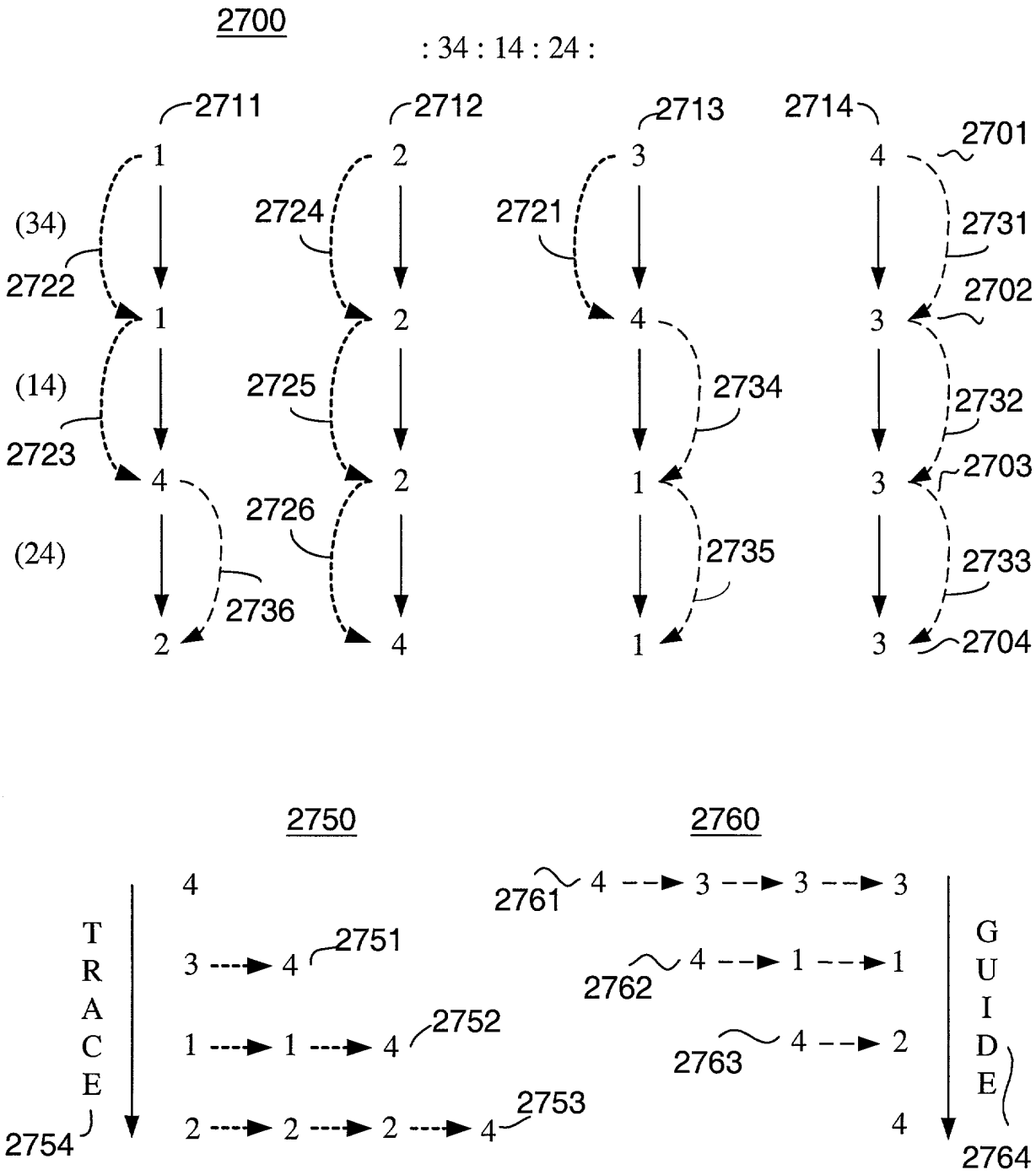

2700
: 34 : 14 : 24 :
2711
2712
2713
2714
2701
2731
2702
2732
2703
2733
2704
2734
2735
2736
(34)
2722
(14)
2723
(24)
2724
2725
2726
2721
2750
2760
TRACE
GUIDE
2751
2752
2753
2754
2761
2762
2763
2764

FIG. 27

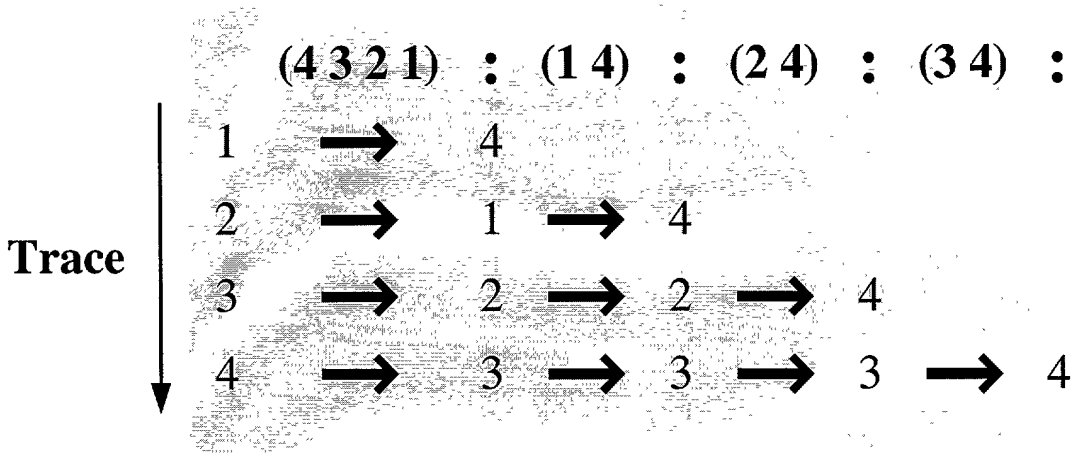


FIG. 28A

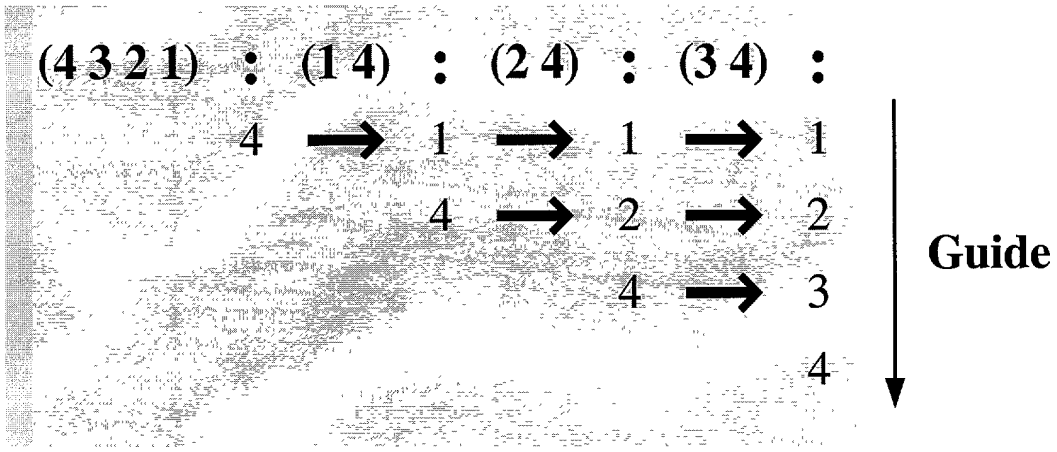


FIG. 28B

FIG. 29

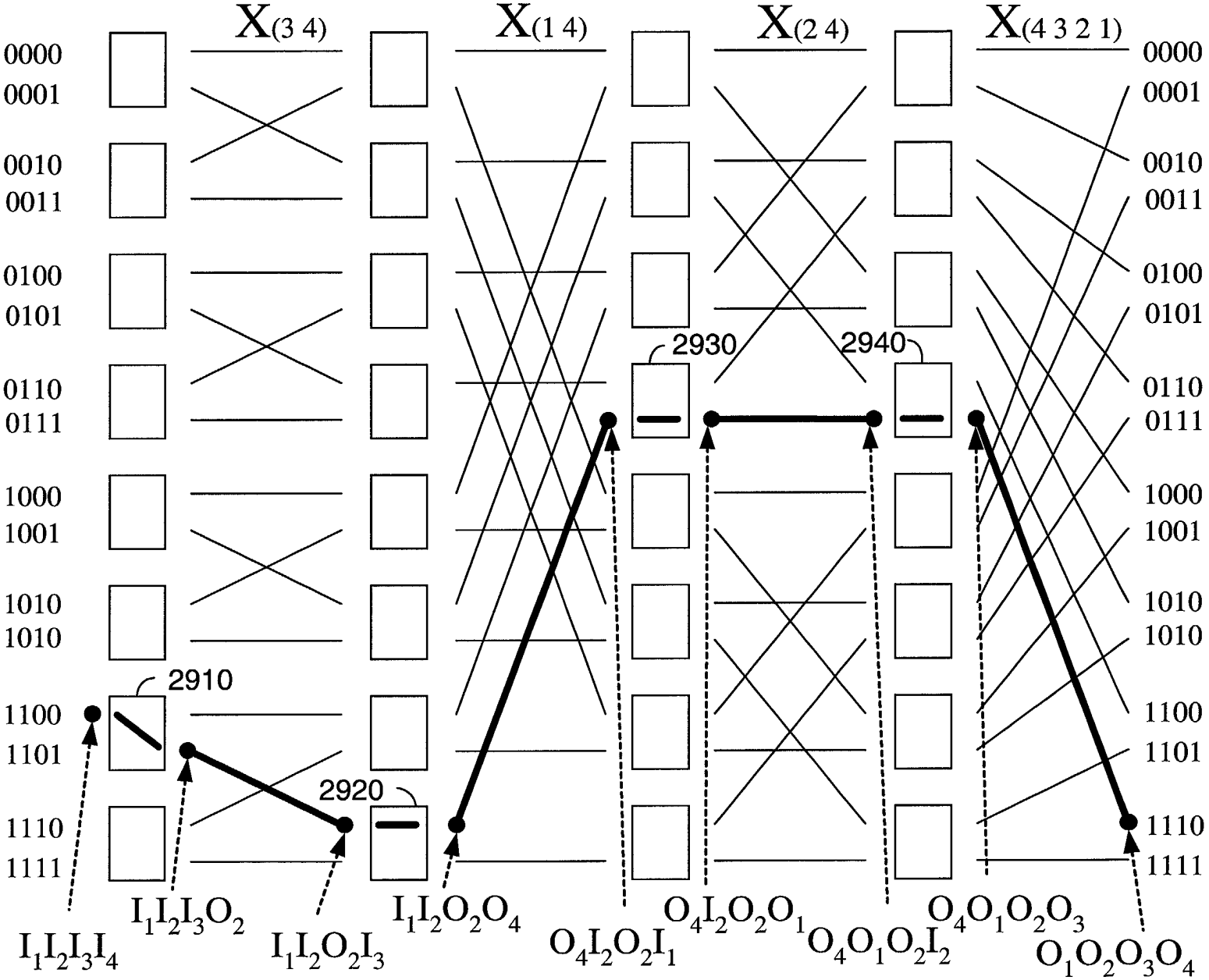


FIG. 30A

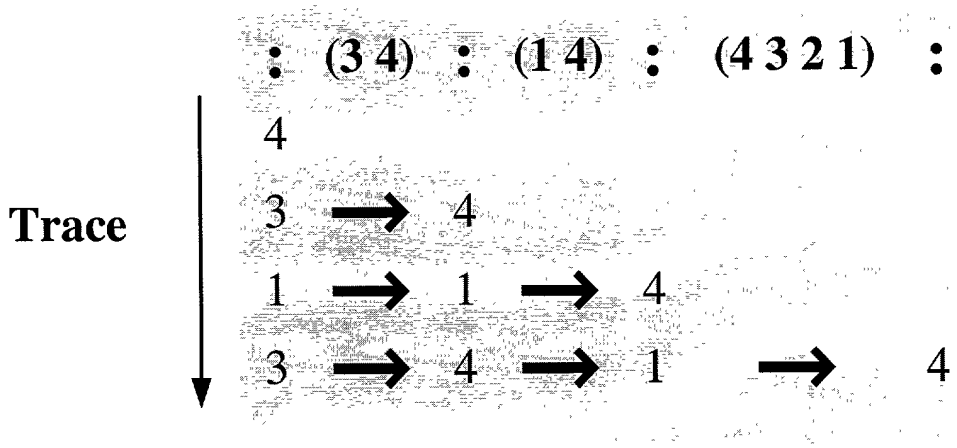
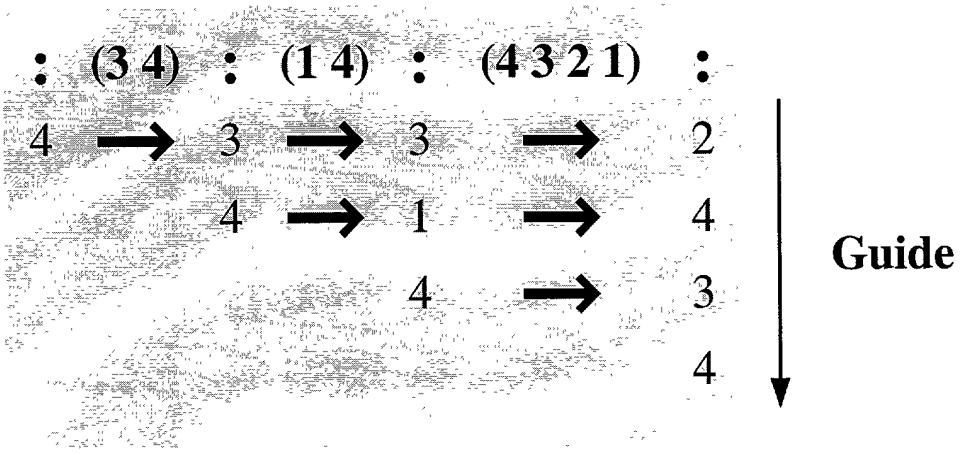


FIG. 30B



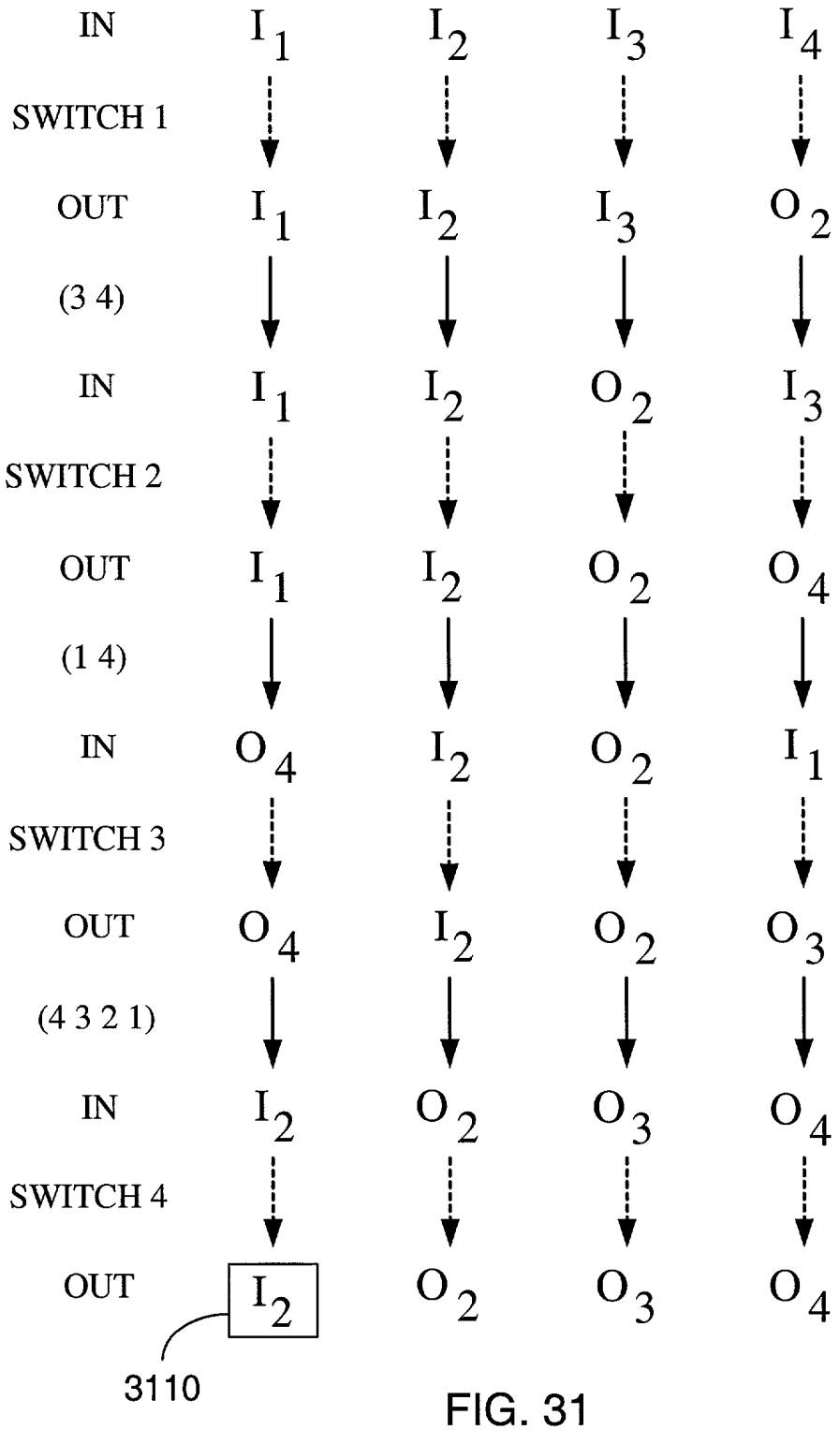

IN
I1 I2 I3 I4
SWITCH 1
OUT
I1 I2 I3 O2
(3 4)
IN
I1 I2 O2 I3
SWITCH 2
OUT
I1 I2 O2 O4
(1 4)
IN
O4 I2 O2 I1
SWITCH 3
OUT
O4 I2 O2 O3
(4 3 2 1)
IN
I2 O2 O3 O4
SWITCH 4
OUT
I2 O2 O3 O4
3110

FIG. 31

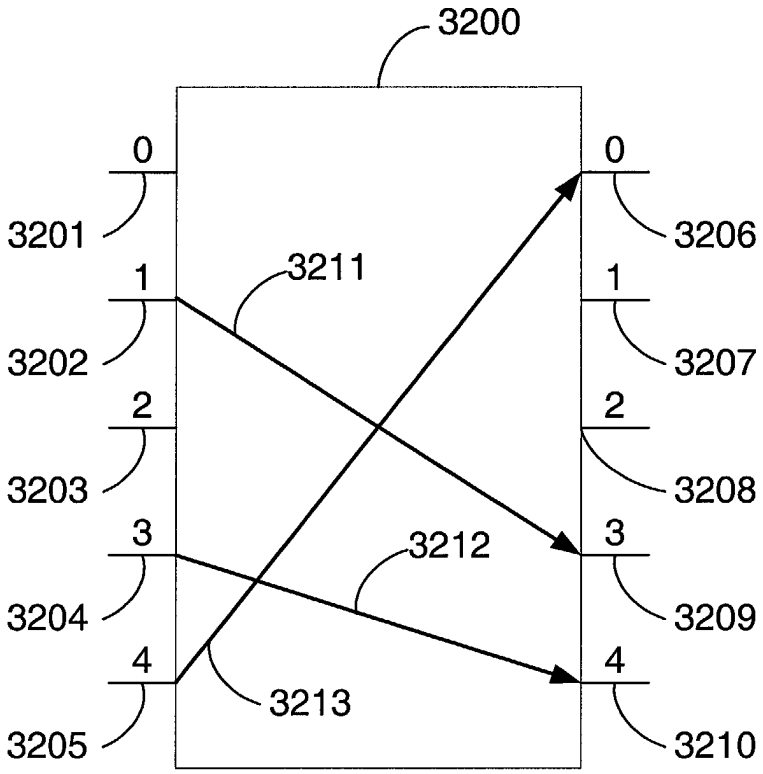


FIG. 32A

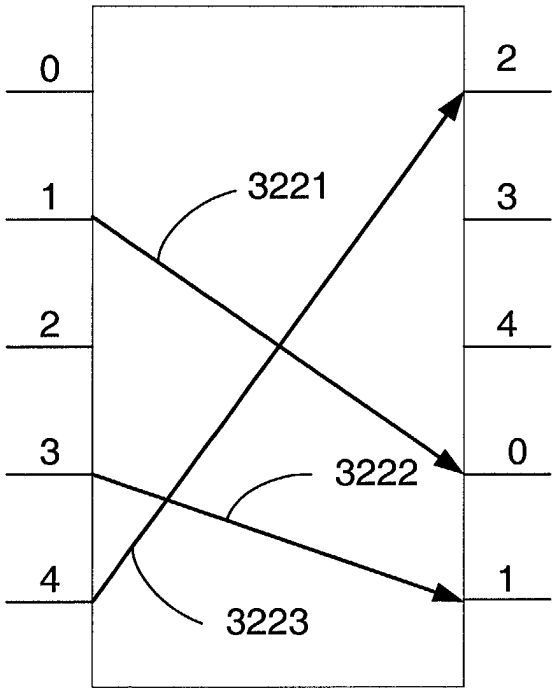


FIG. 32B

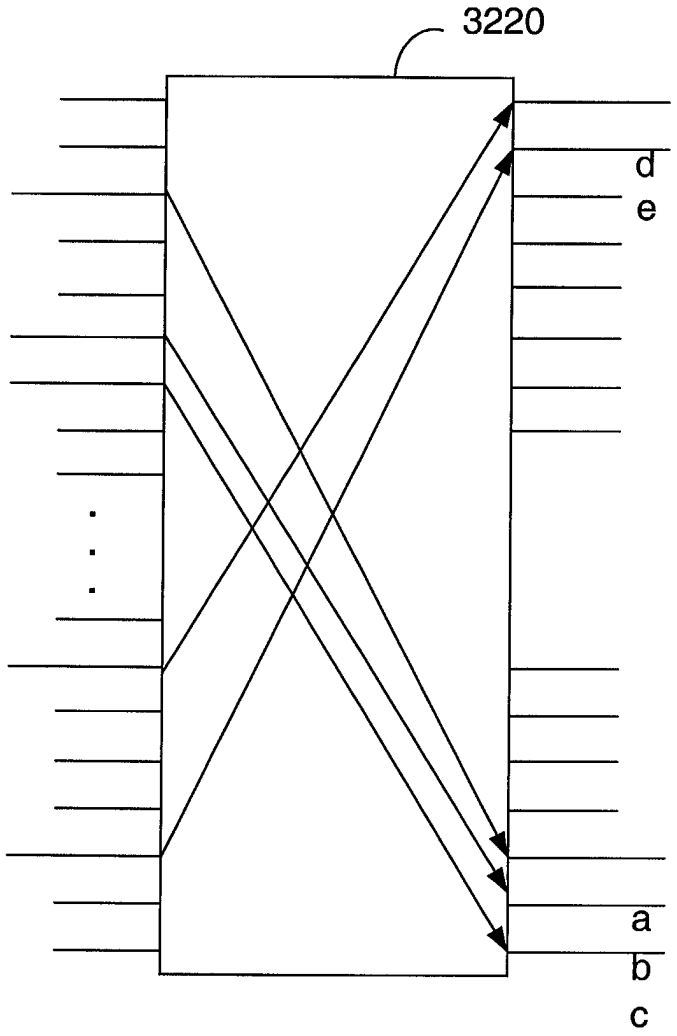


FIG. 32C

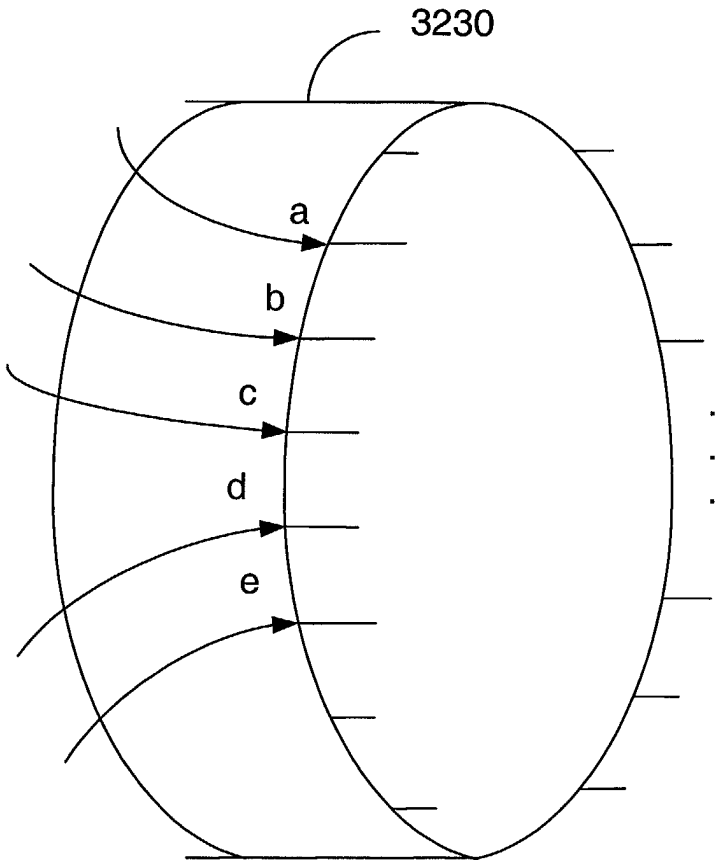


FIG. 32D

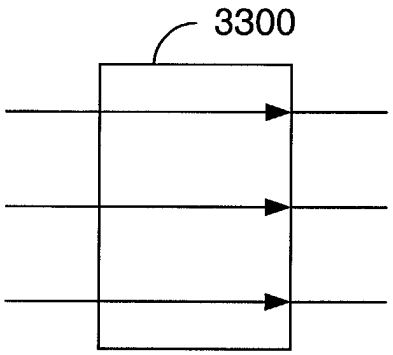


FIG. 33A

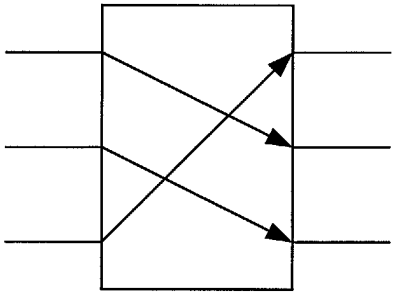


FIG. 33B

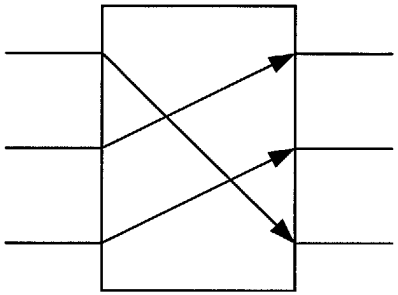


FIG. 33C

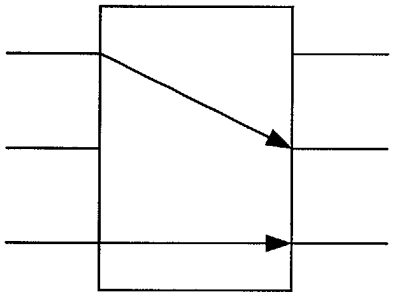


FIG. 33D

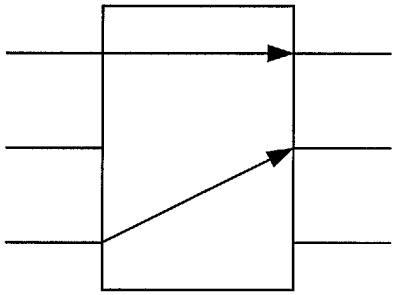


FIG. 33E

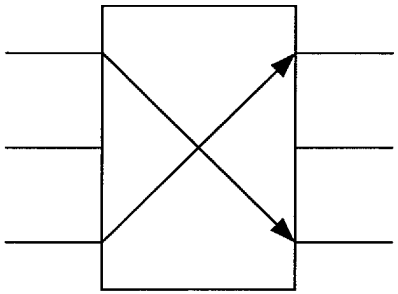


FIG.33F

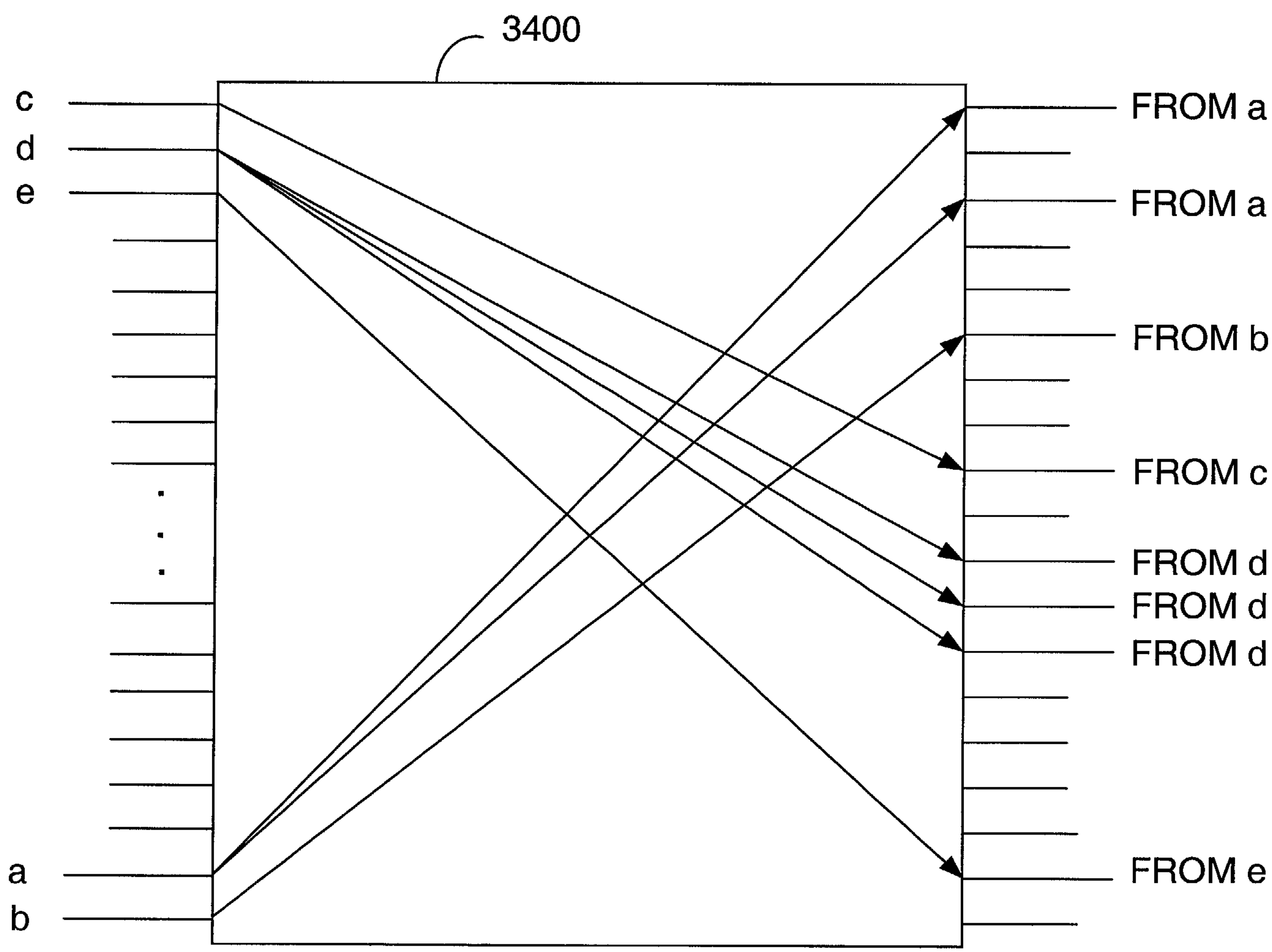


FIG. 34

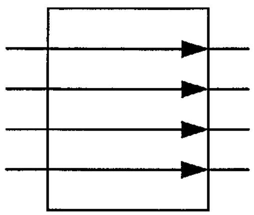


FIG. 35A

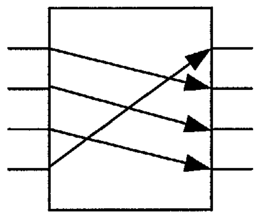


FIG. 35B

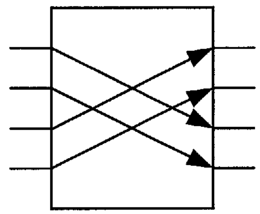


FIG. 35C

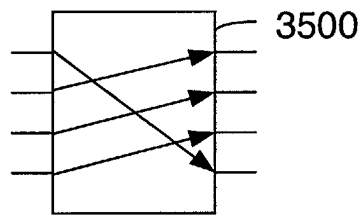


FIG. 35D

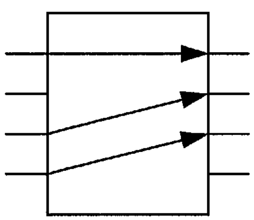


FIG. 35E

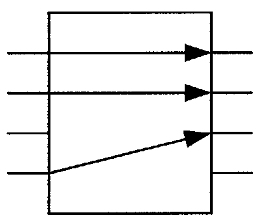


FIG. 35F

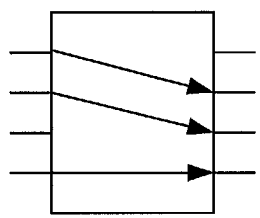


FIG. 35G

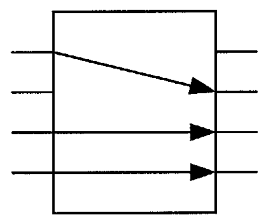


FIG. 35H

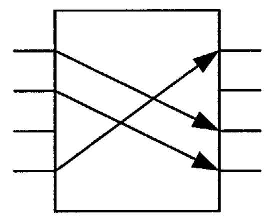


FIG. 35I

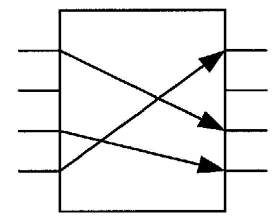


FIG. 35J

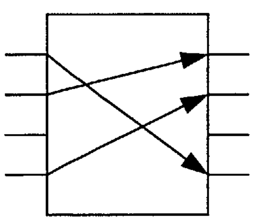


FIG. 35K

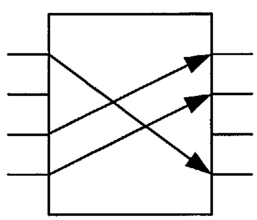


FIG. 35L

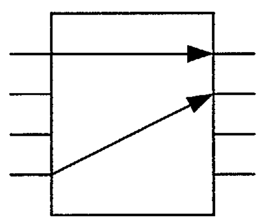


FIG. 35M

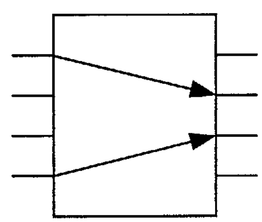


FIG. 35N

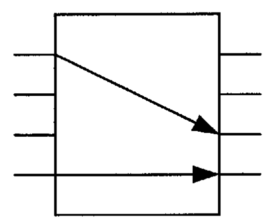


FIG. 35O

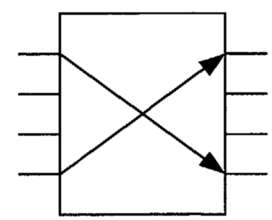


FIG. 35P

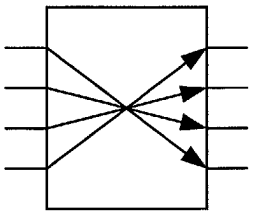


FIG. 36A

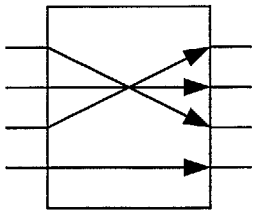


FIG. 36B

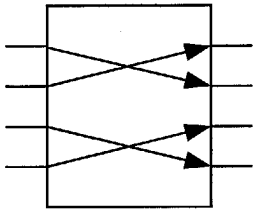


FIG. 36C

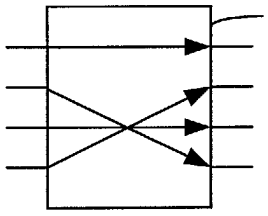


FIG. 36D

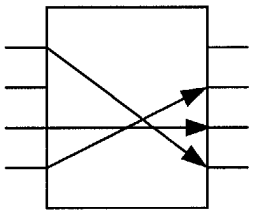


FIG. 36E

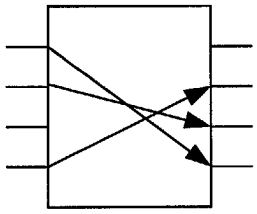


FIG. 36F

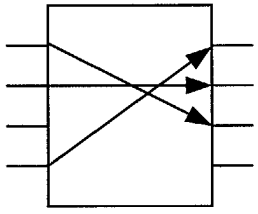


FIG. 36G

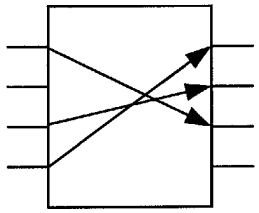


FIG. 36H

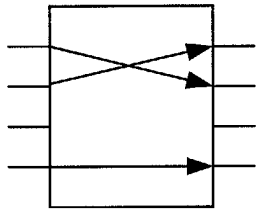


FIG. 36I

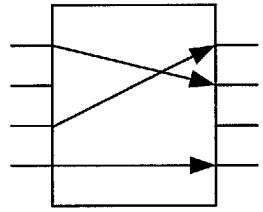


FIG. 36J

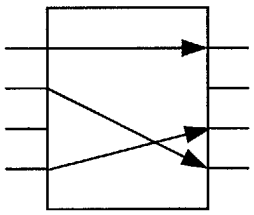


FIG. 36K

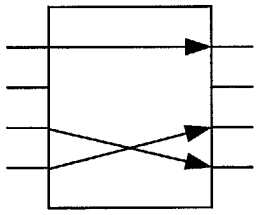


FIG. 36L

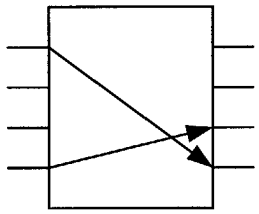


FIG. 36M

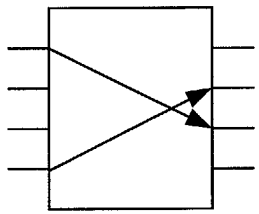


FIG. 36N

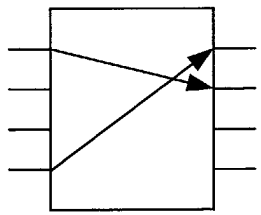


FIG. 36O

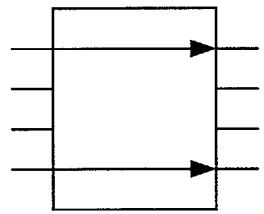


FIG. 36P

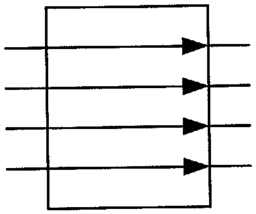


FIG. 37A

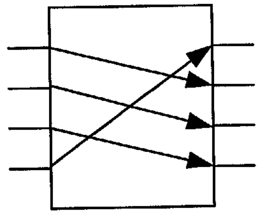


FIG. 37B

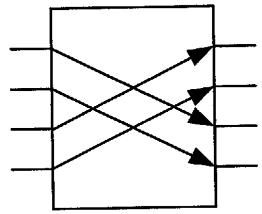


FIG. 37C

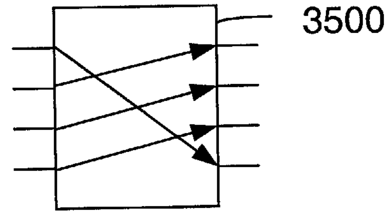


FIG. 37D

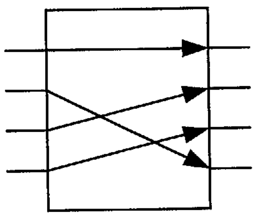


FIG. 37E

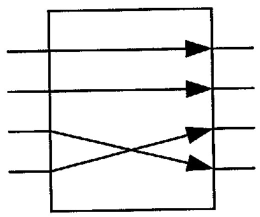


FIG. 37F

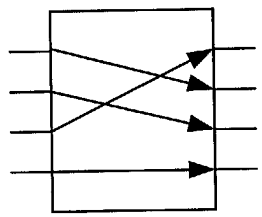


FIG. 37G

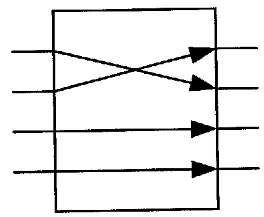


FIG. 37H

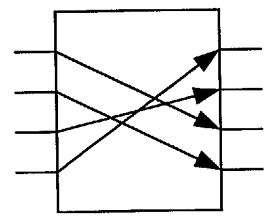


FIG. 37I

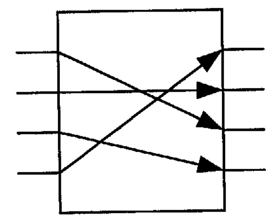


FIG. 37J

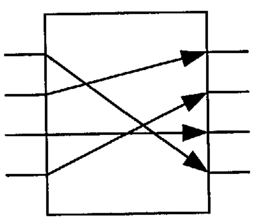


FIG. 37K

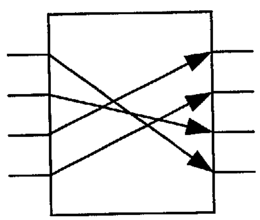


FIG. 37L

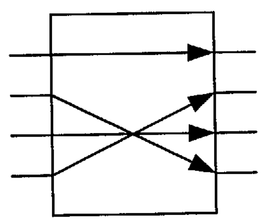


FIG. 37M

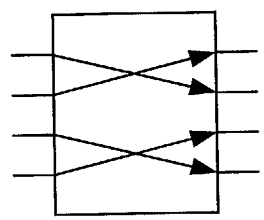


FIG. 37N

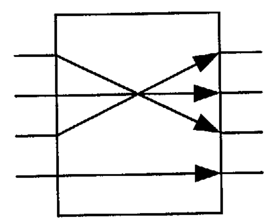


FIG. 37O

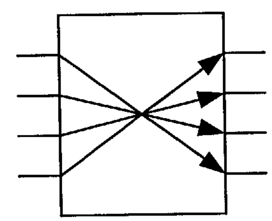
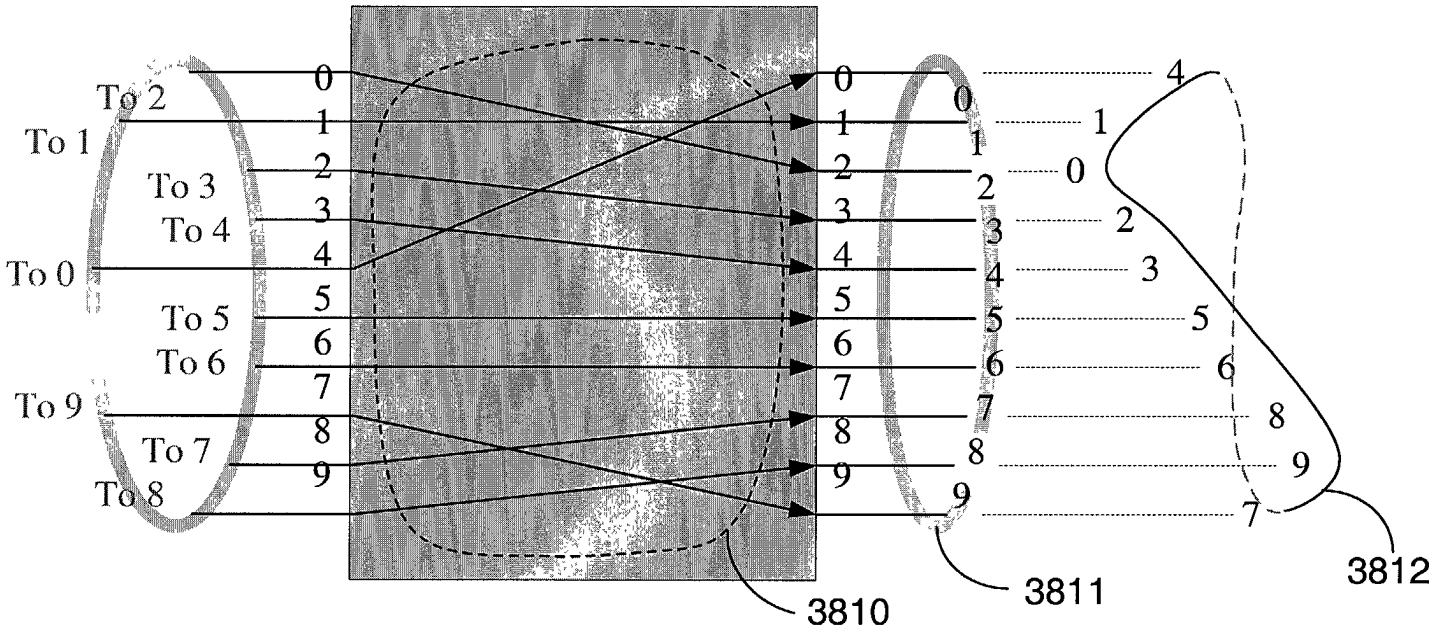


FIG. 37P


To 2
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3812

FIG. 38A

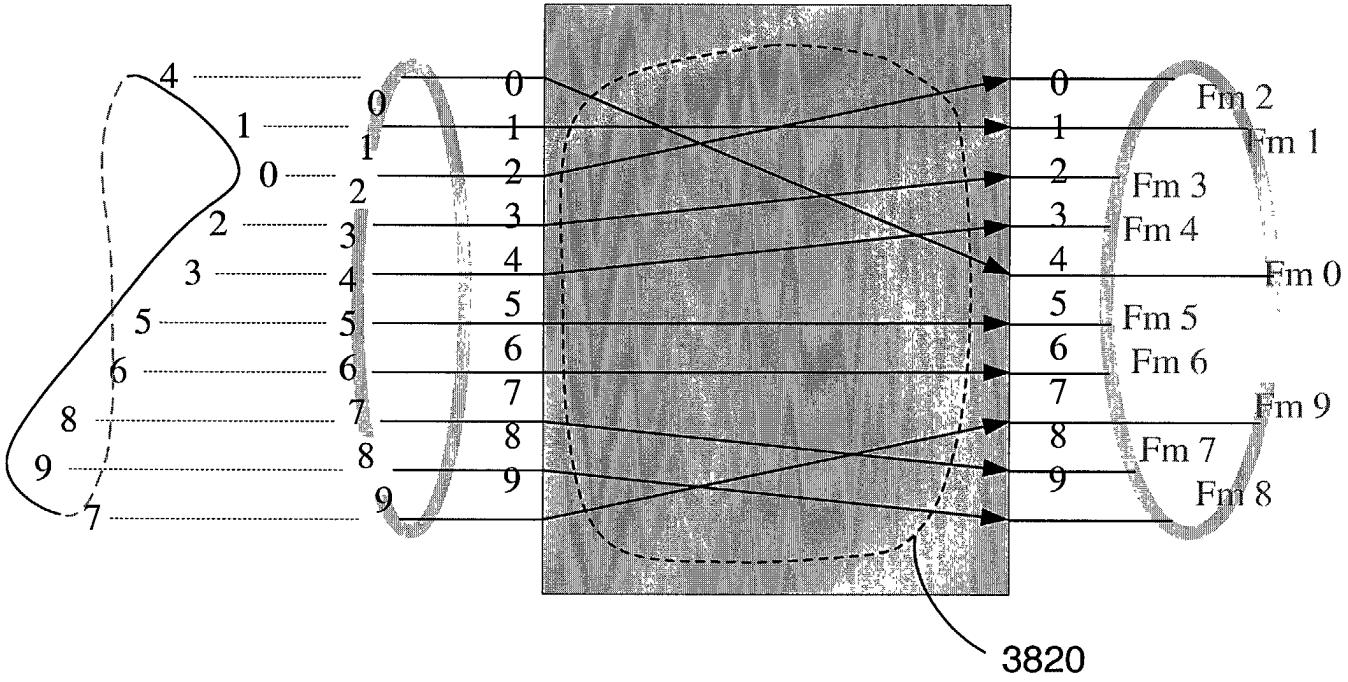


FIG.38B

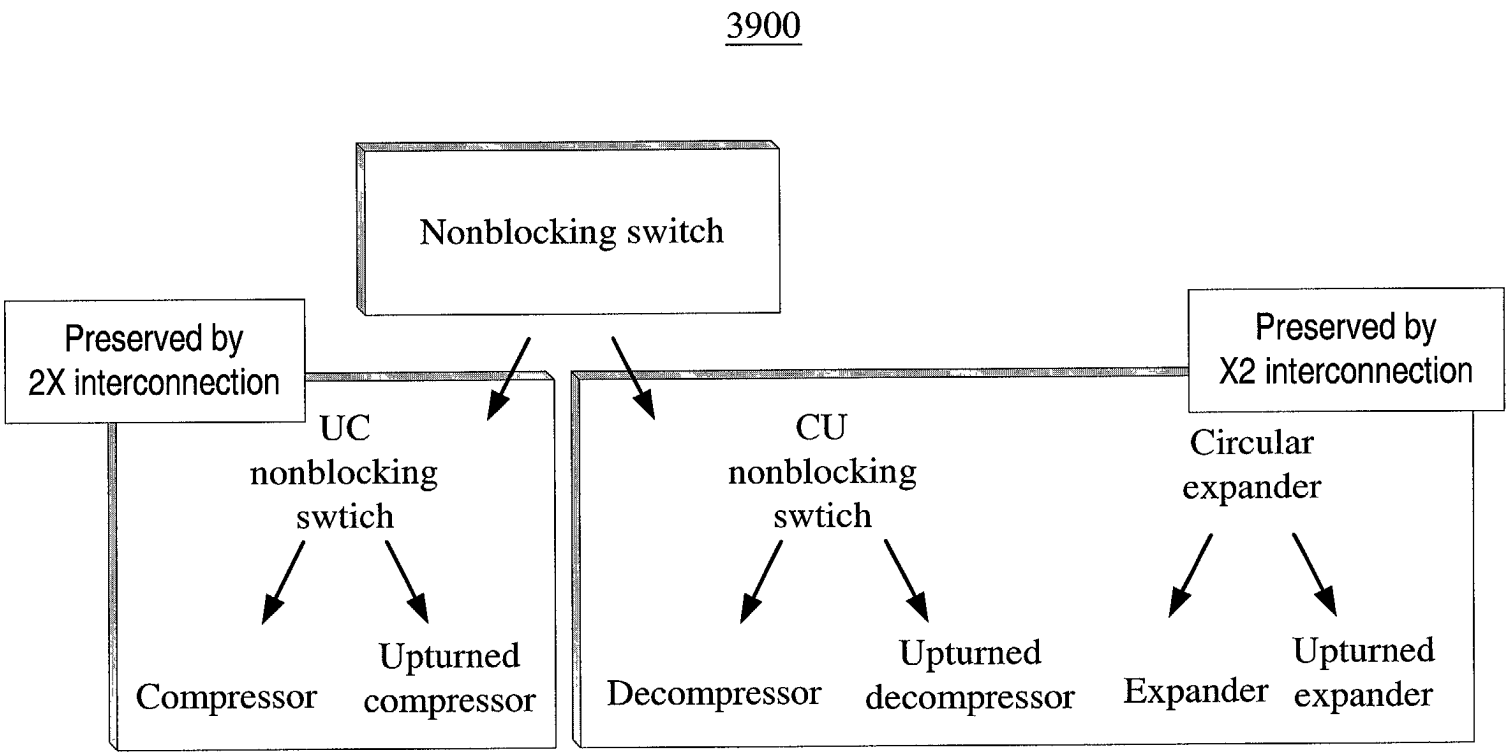

3900
Nonblocking switch
Preserved by 2X interconnection
Preserved by X2 interconnection
UC nonblocking swtich
CU nonblocking swtich
Circular expander
Compressor
Upturned compressor
Decompressor
Upturned decompressor
Expander
Upturned expander

FIG. 39

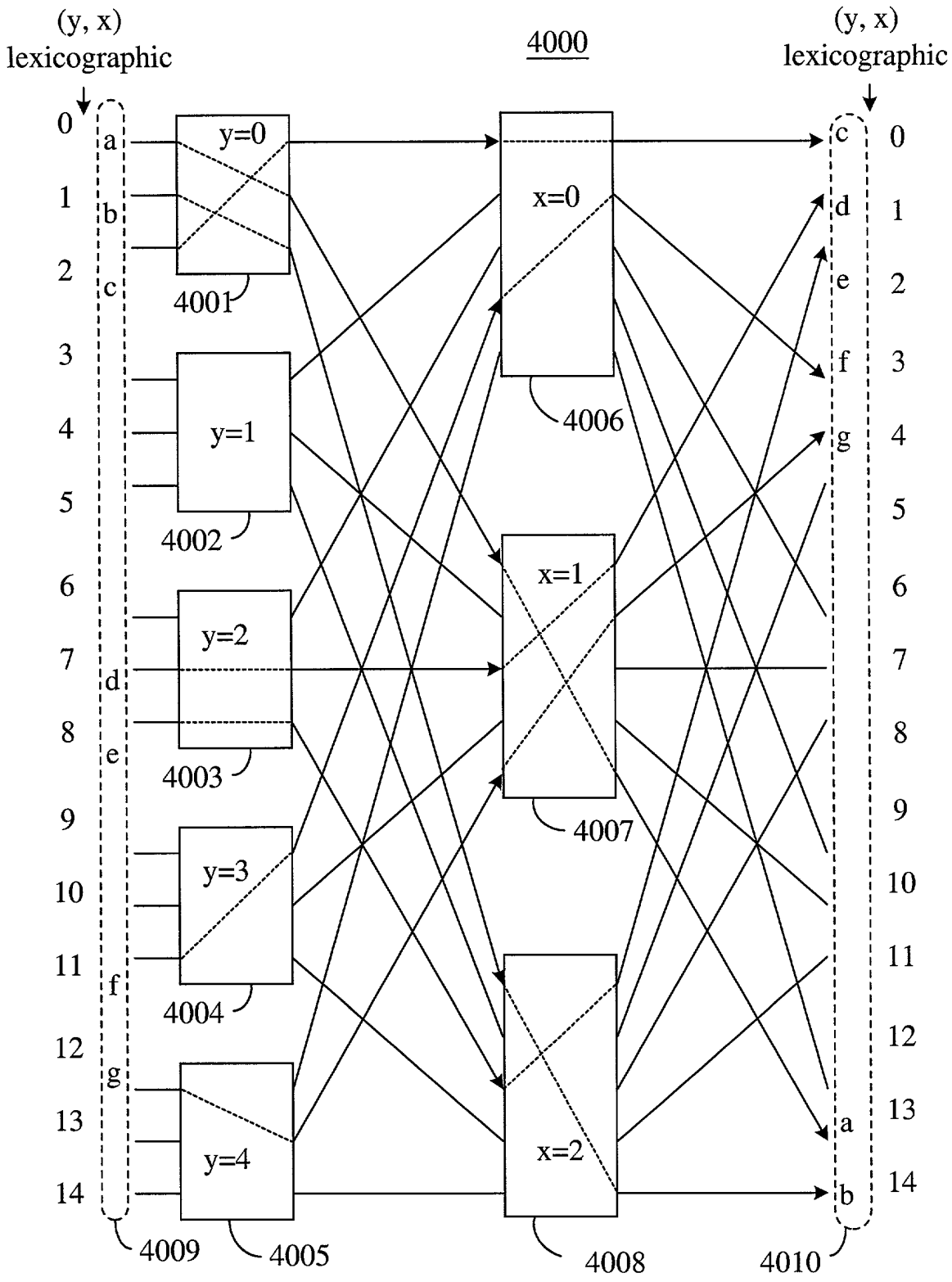

(y, x)
lexicographic
4000
(y, x)
lexicographic
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
a
b
c
d
e
f
g
y=0
y=1
y=2
y=3
y=4
x=0
x=1
x=2
4001
4002
4003
4004
4005
4006
4007
4008
4009
4010
c
d
e
f
g
a
b
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

FIG. 40

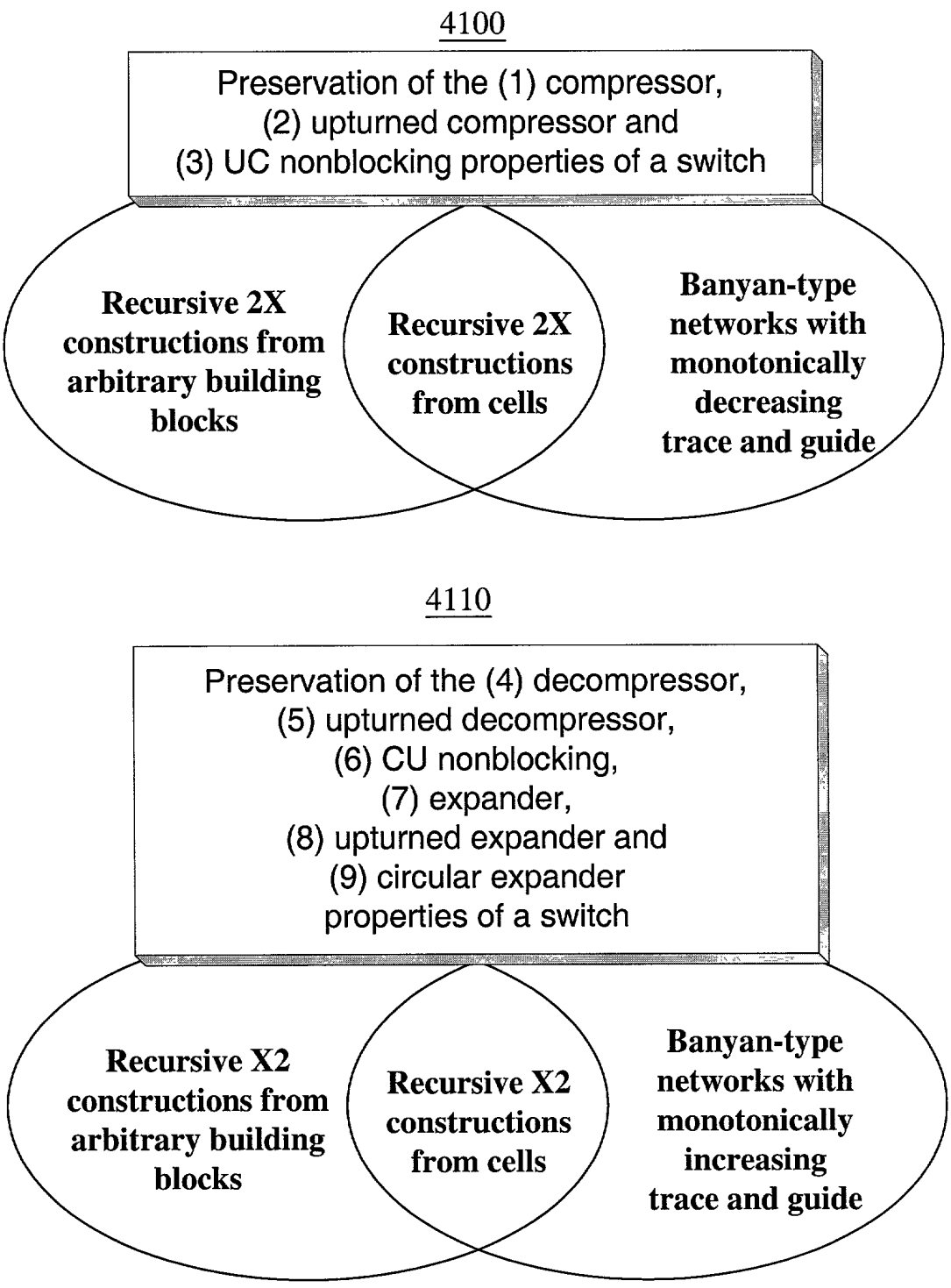


FIG. 41

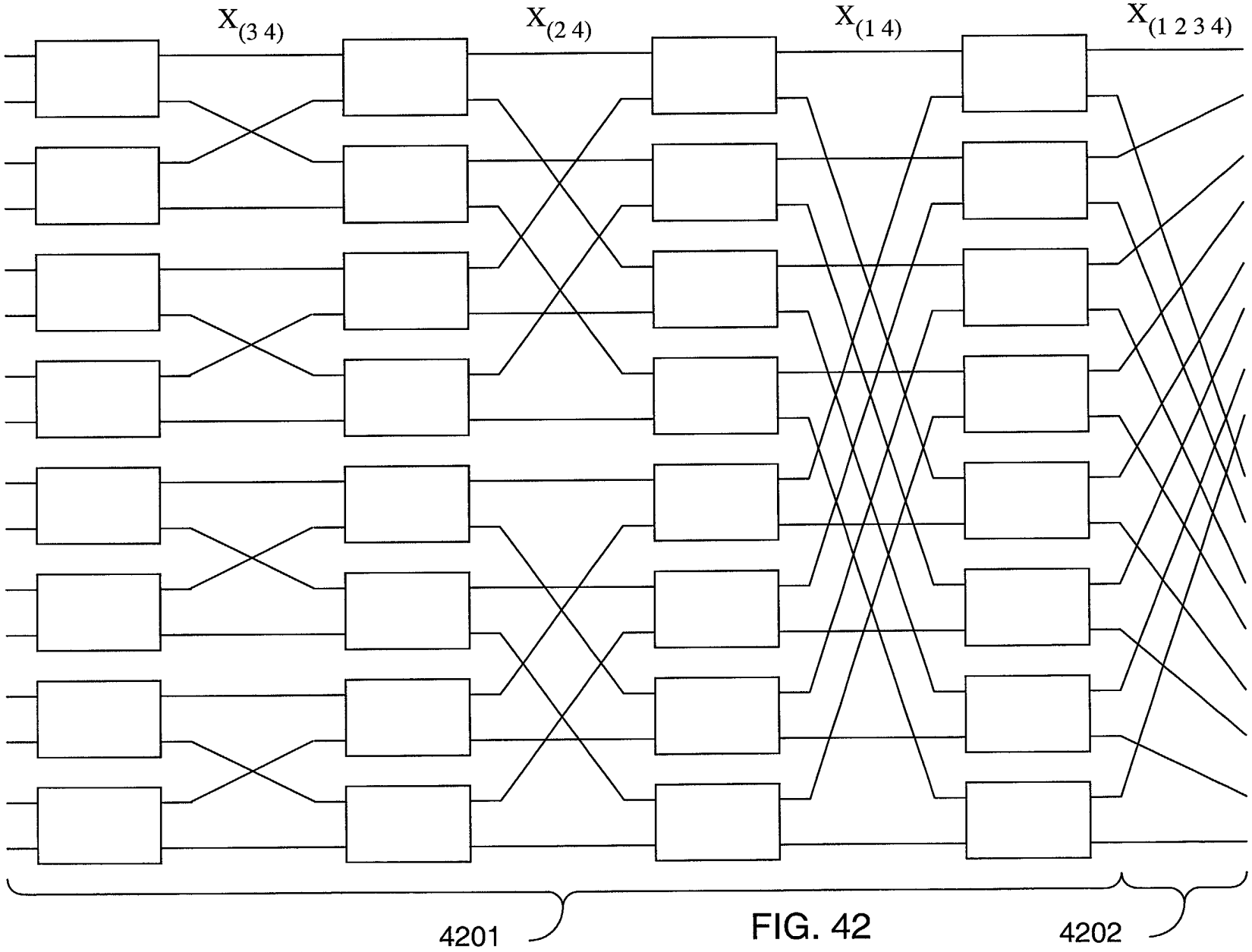


FIG. 42

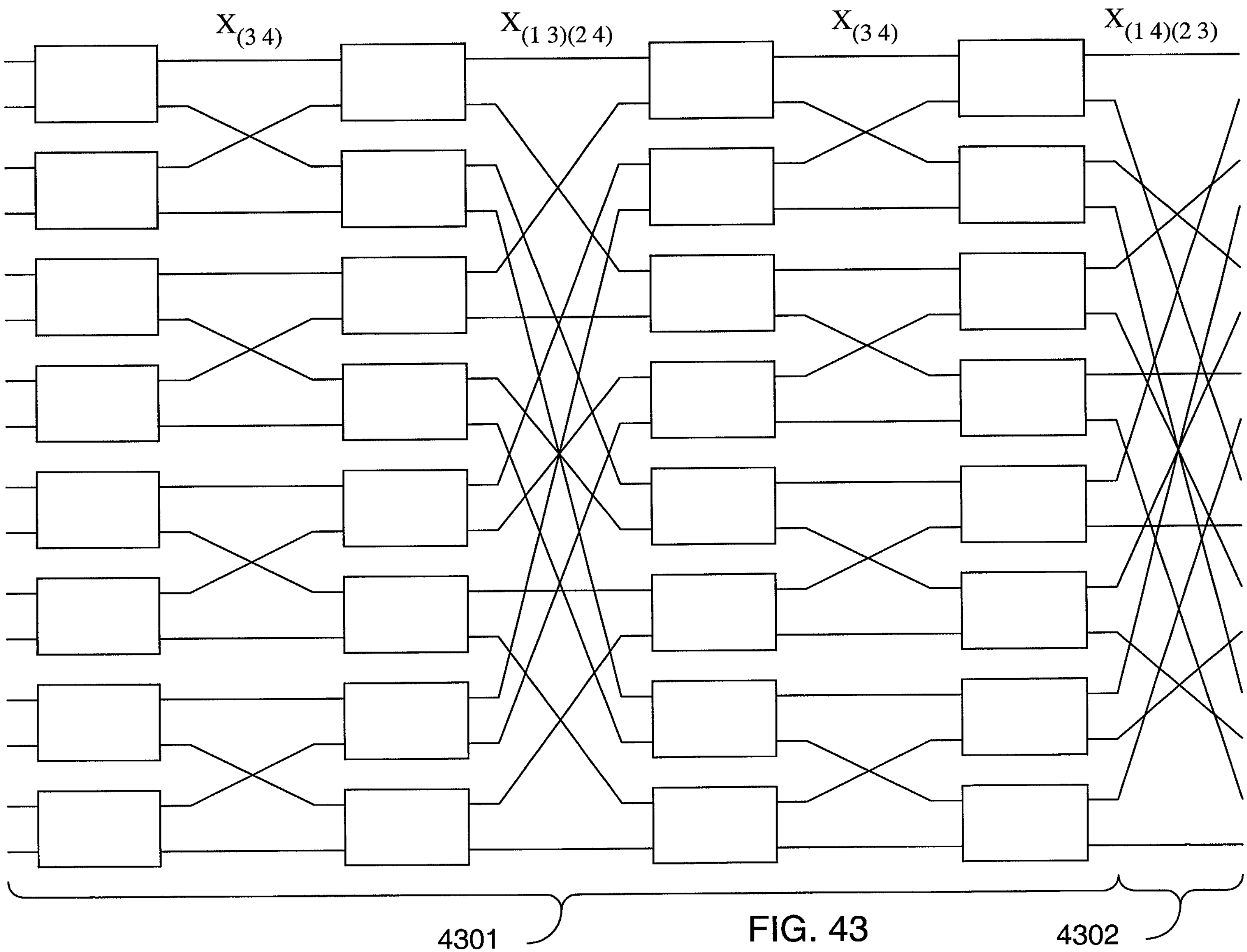


FIG. 43

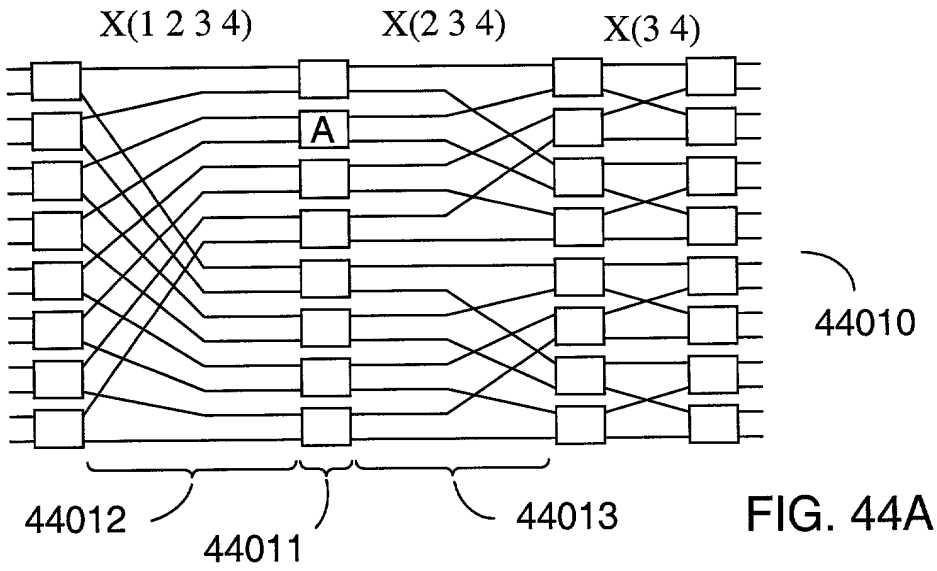


FIG. 44A

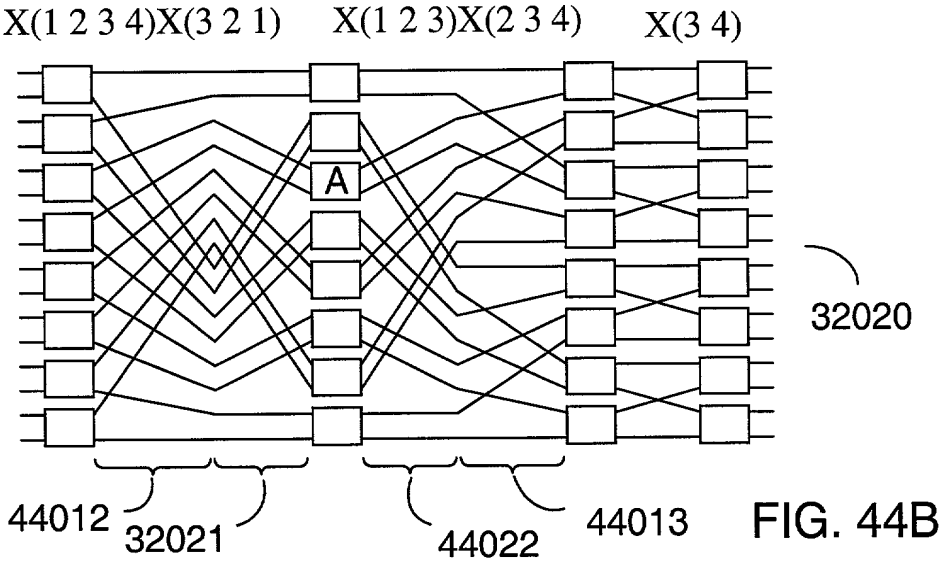


FIG. 44B

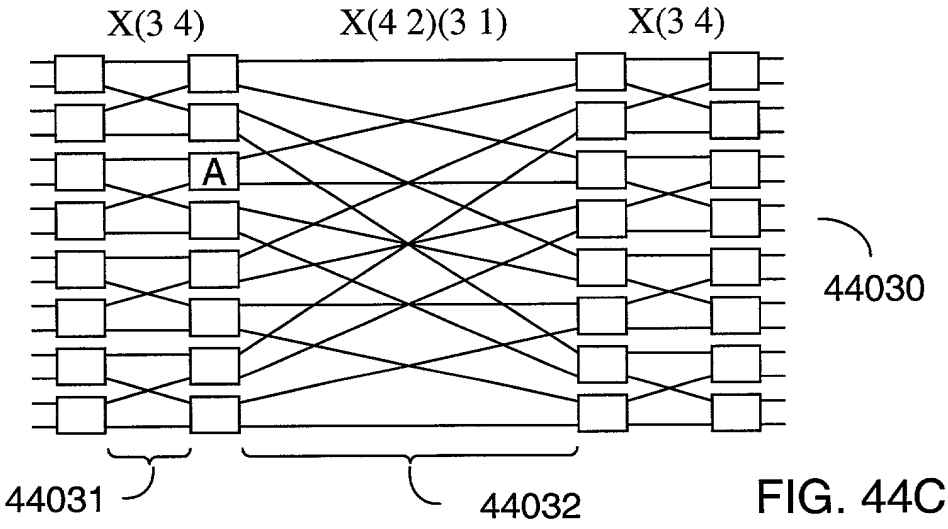


FIG. 44C

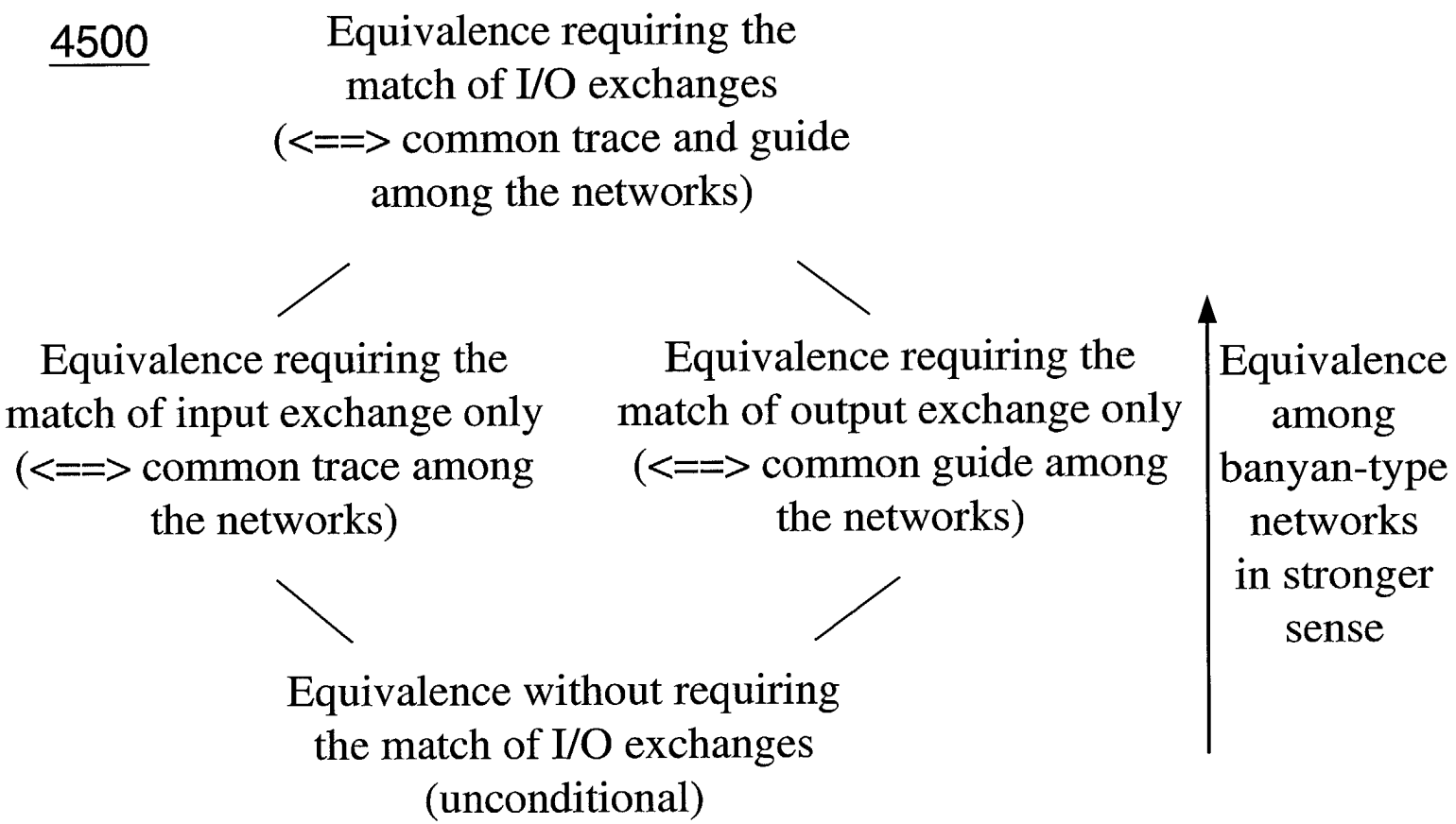

4500
Equivalence requiring the match of I/O exchanges (<==> common trace and guide among the networks)
Equivalence requiring the match of input exchange only (<==> common trace among the networks)
Equivalence requiring the match of output exchange only (<==> common guide among the networks)
Equivalence without requiring the match of I/O exchanges (unconditional)
Equivalence among banyan-type networks in stronger sense

FIG. 45

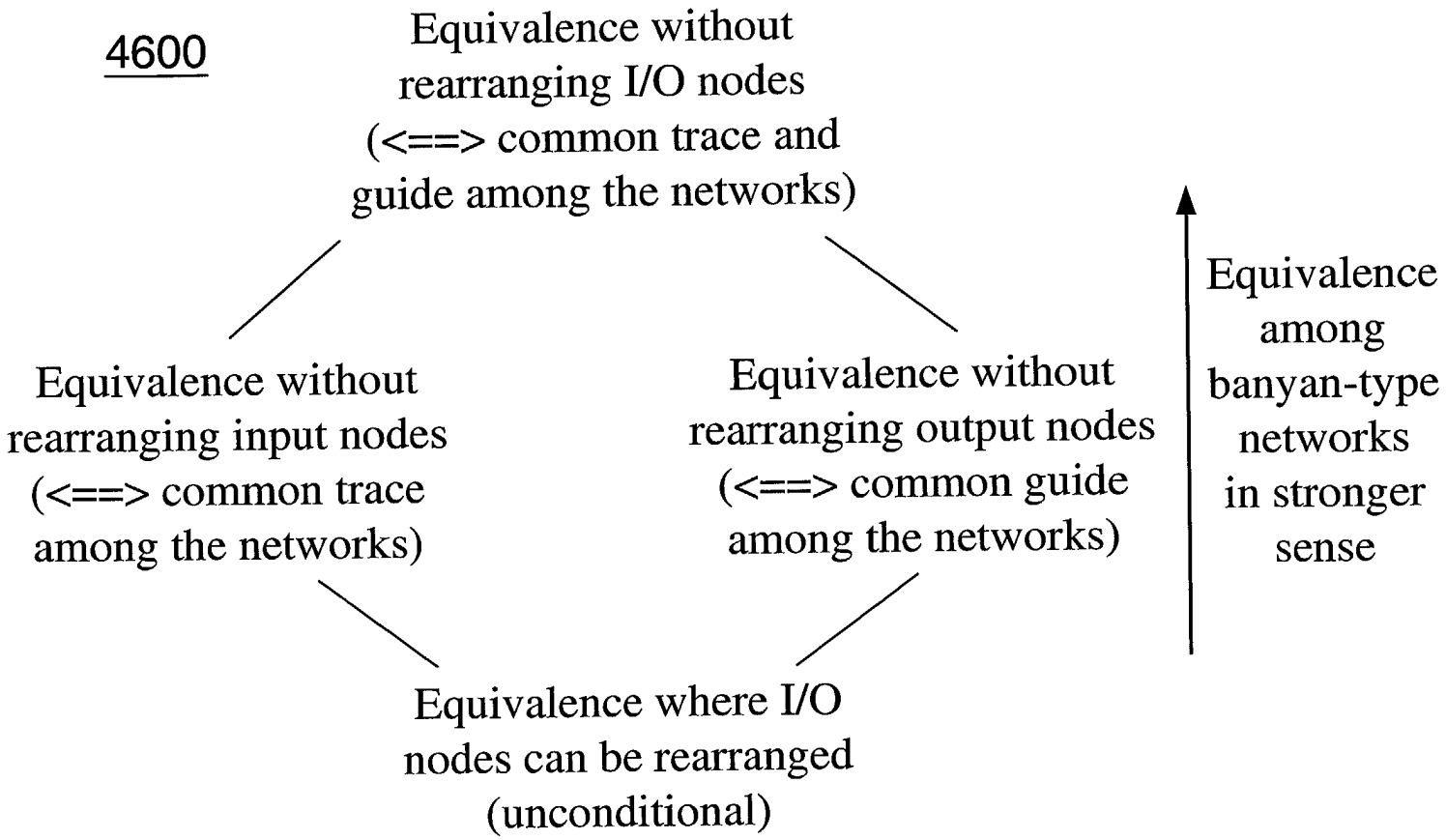

4600
Equivalence without rearranging I/O nodes (<==> common trace and guide among the networks)
Equivalence without rearranging input nodes (<==> common trace among the networks)
Equivalence without rearranging output nodes (<==> common guide among the networks)
Equivalence where I/O nodes can be rearranged (unconditional)
Equivalence among banyan-type networks in stronger sense

FIG. 46

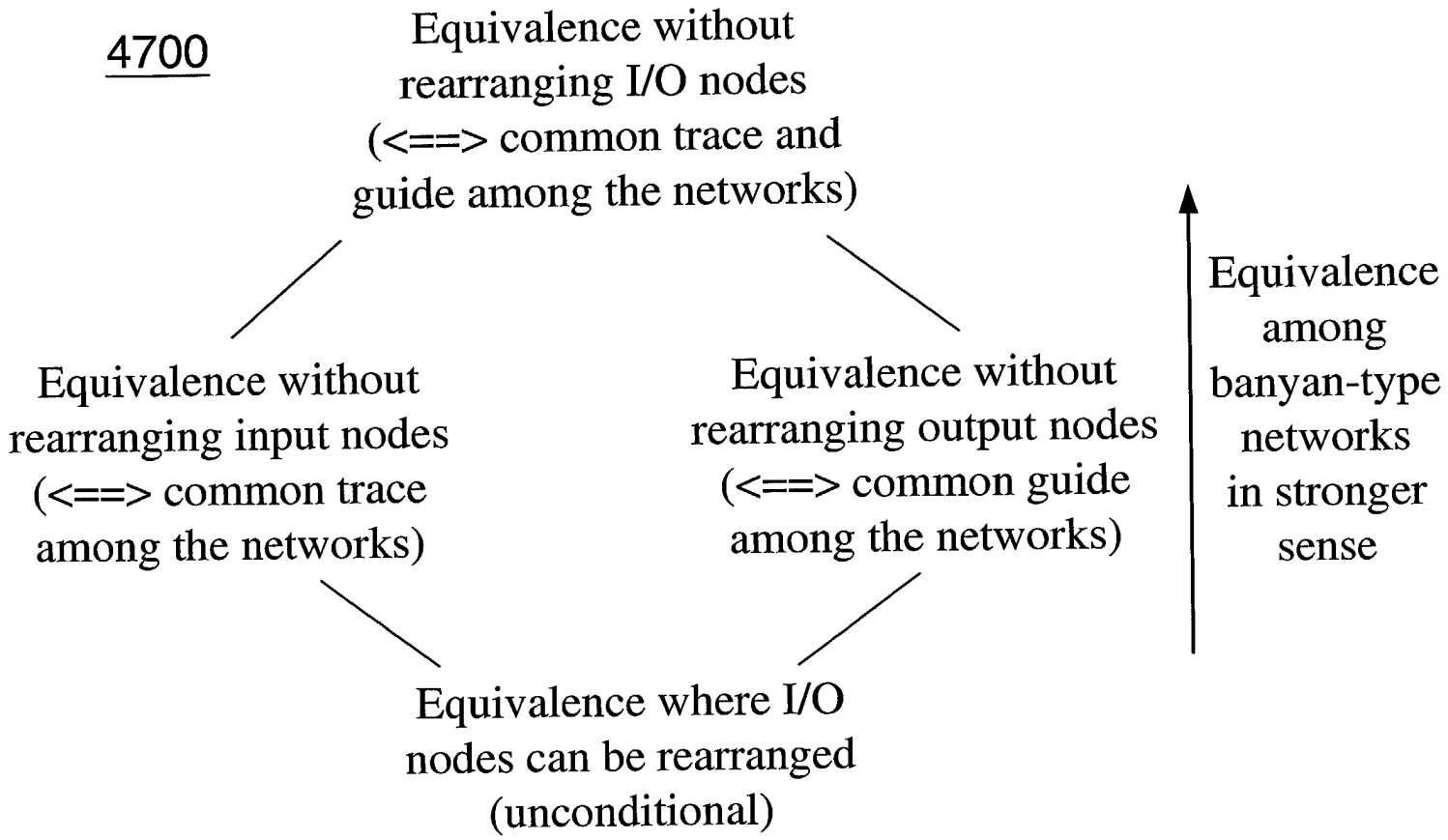


FIG. 47

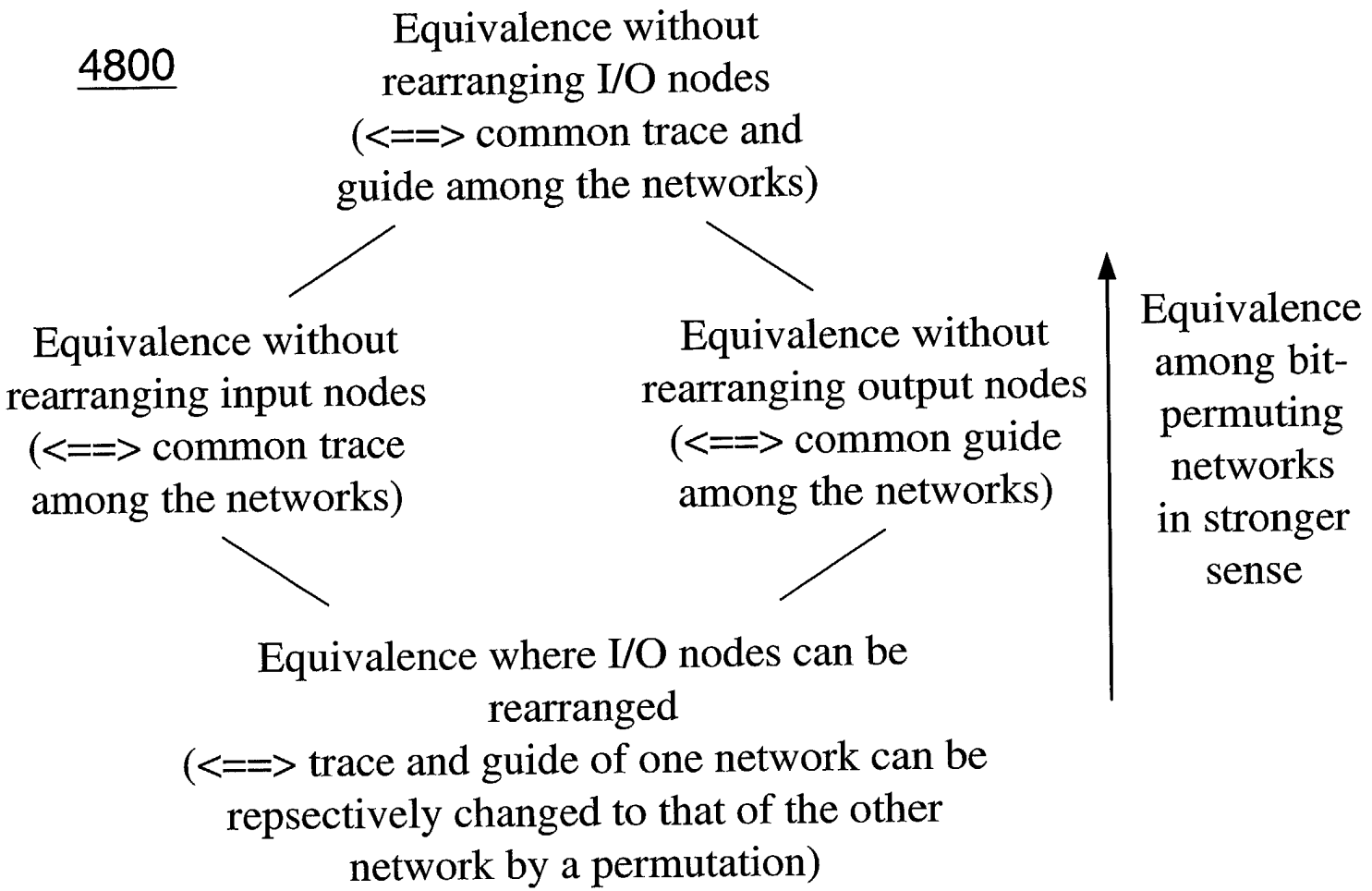


FIG. 48

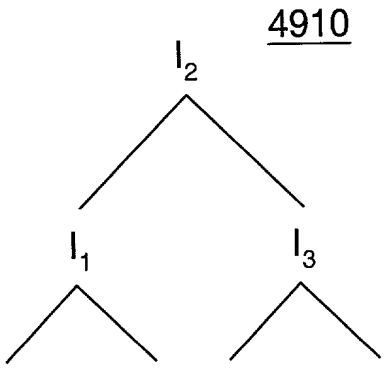


FIG. 49A

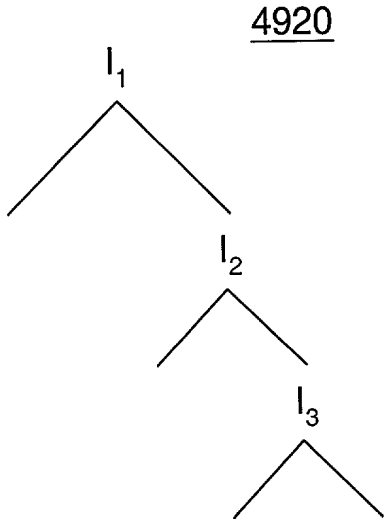


FIG. 49B

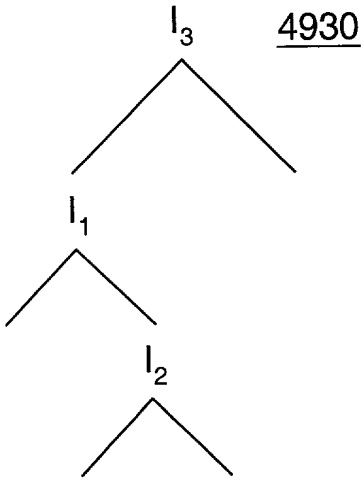


FIG. 49C

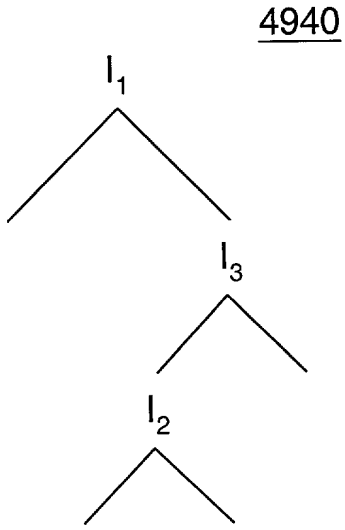


FIG. 49D

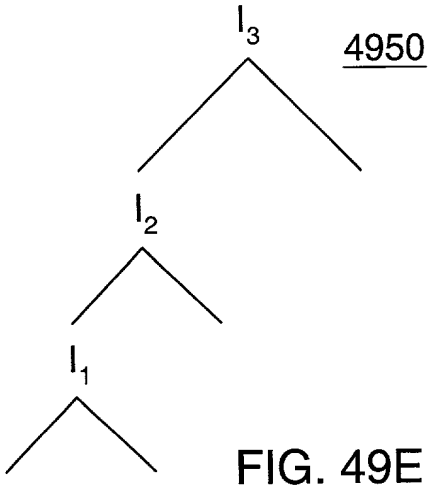


FIG. 49E

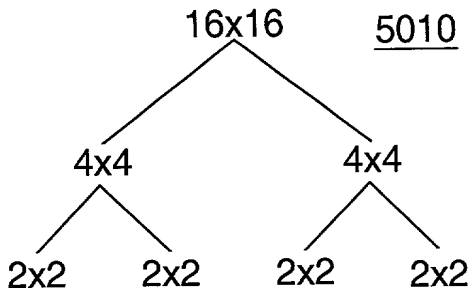


FIG. 50A

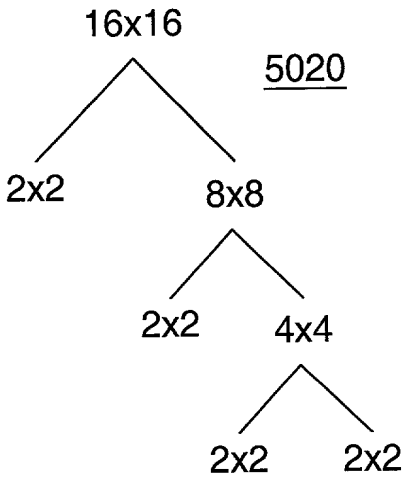


FIG. 50B

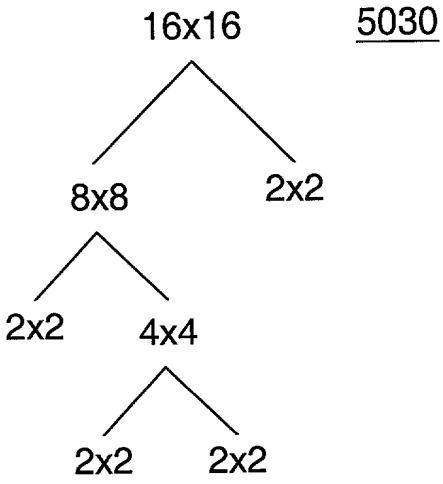


FIG. 50C

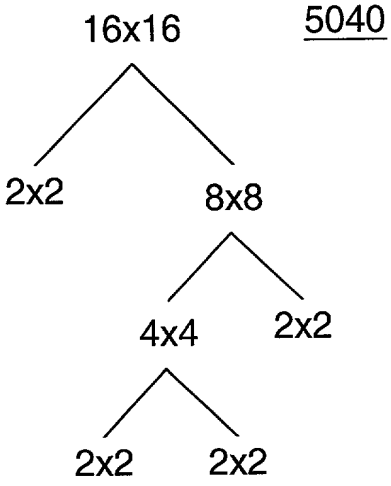


FIG. 50D

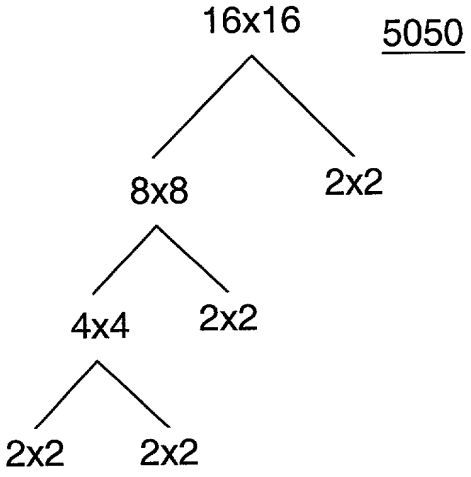


FIG. 50E

5100

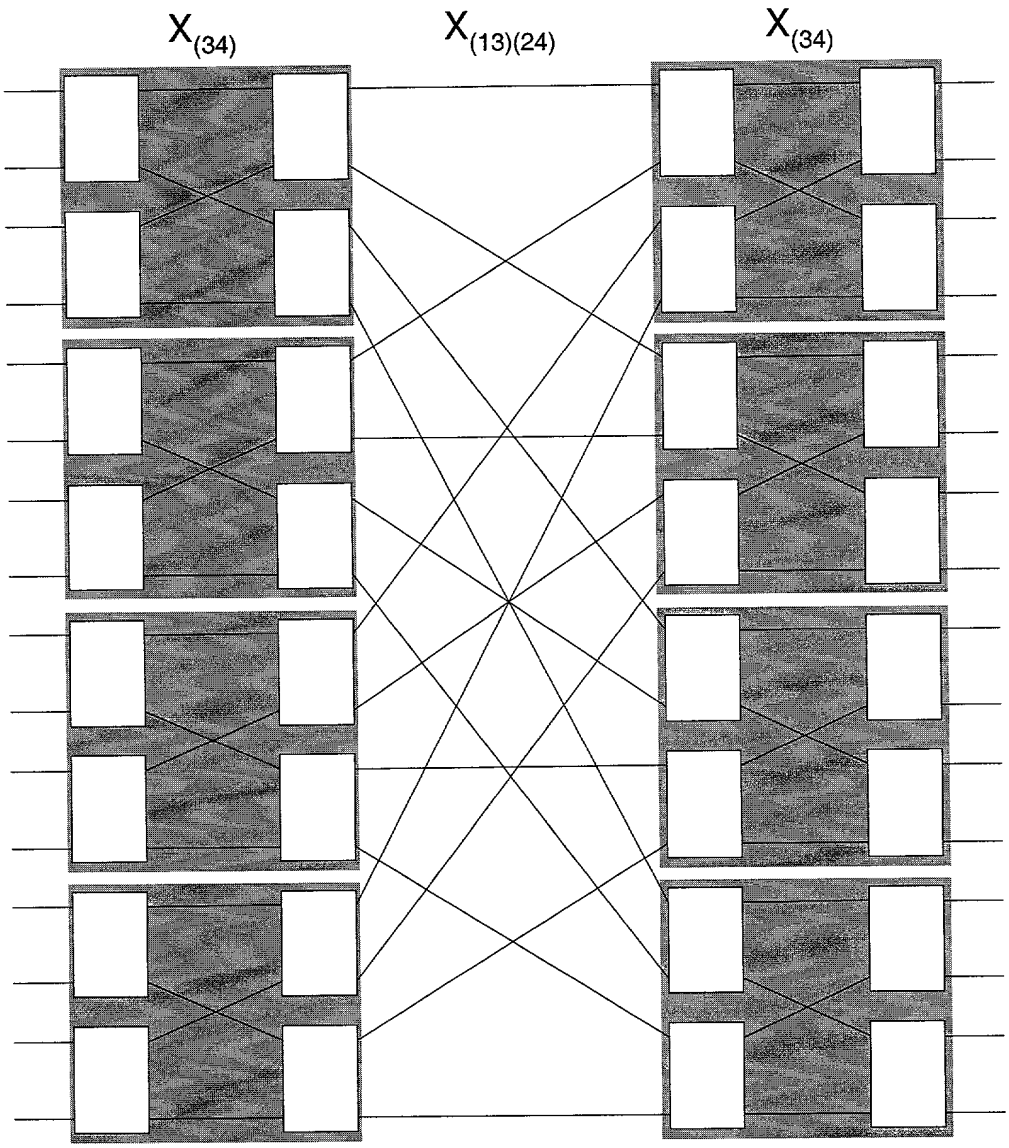


FIG. 51

5200

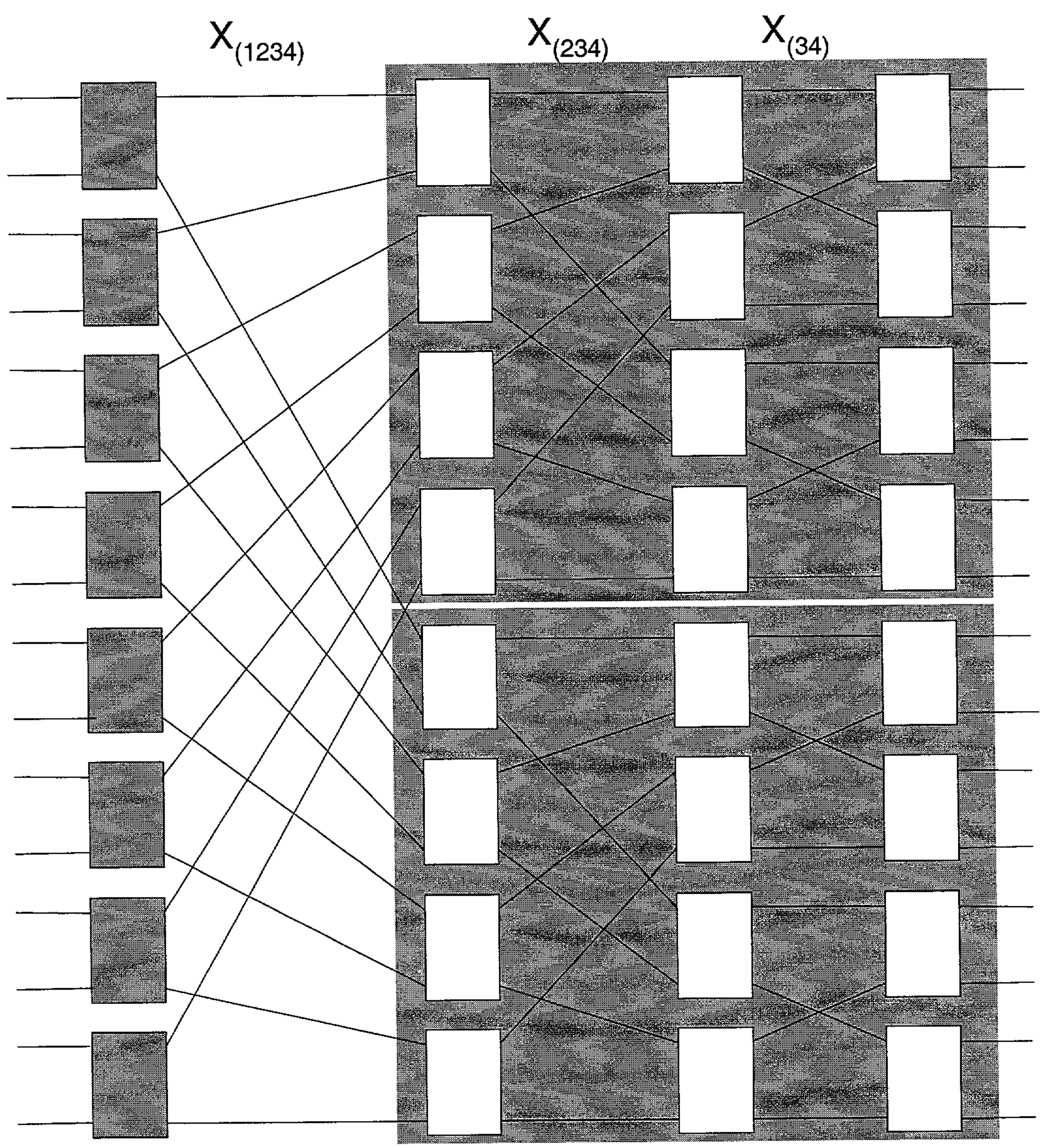
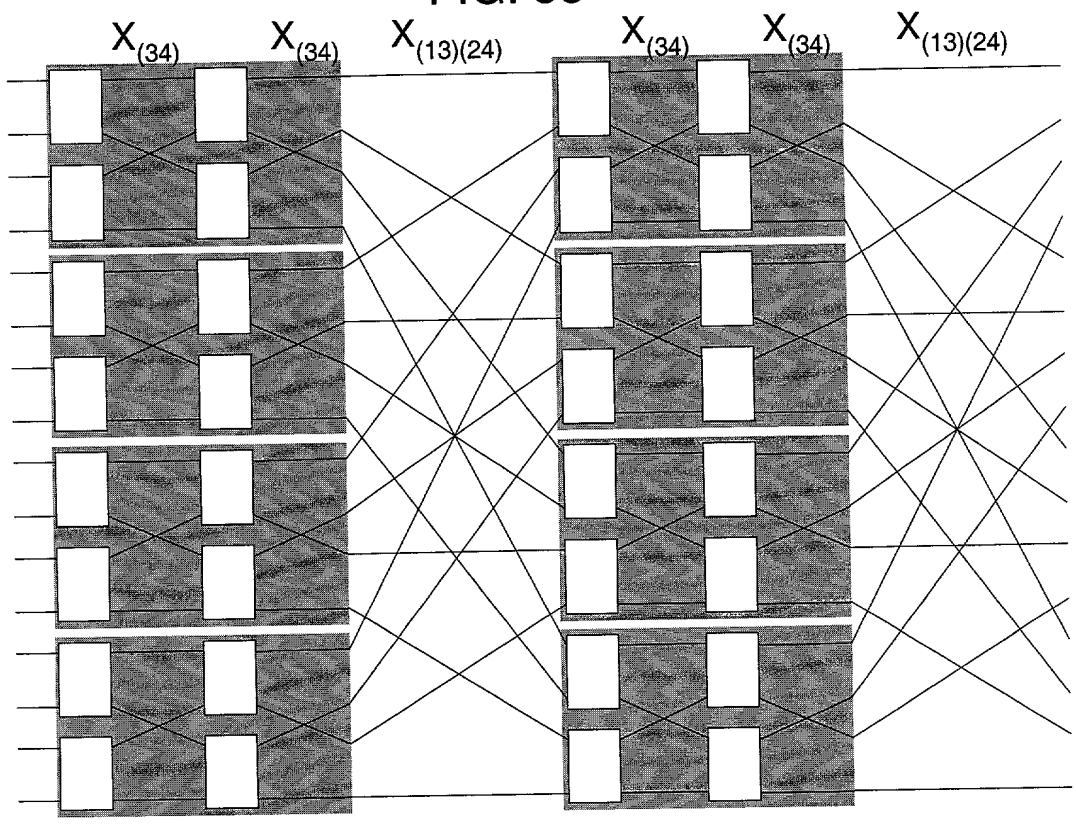
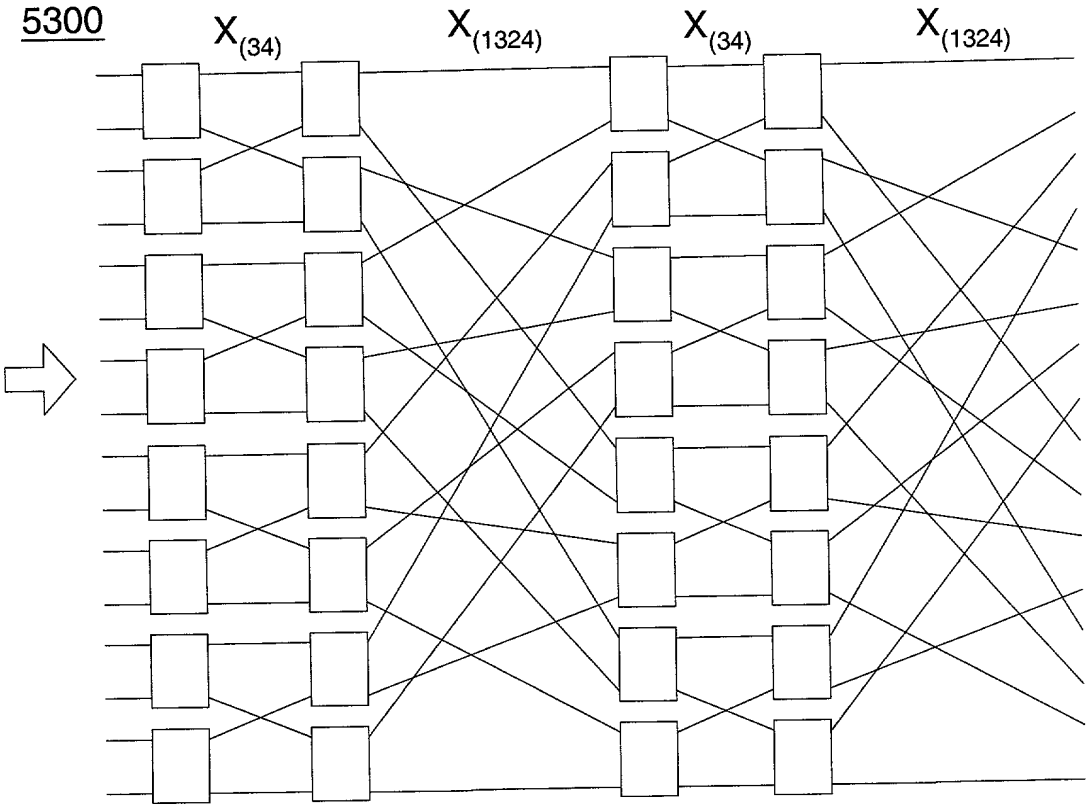


FIG. 52

FIG. 53





5400

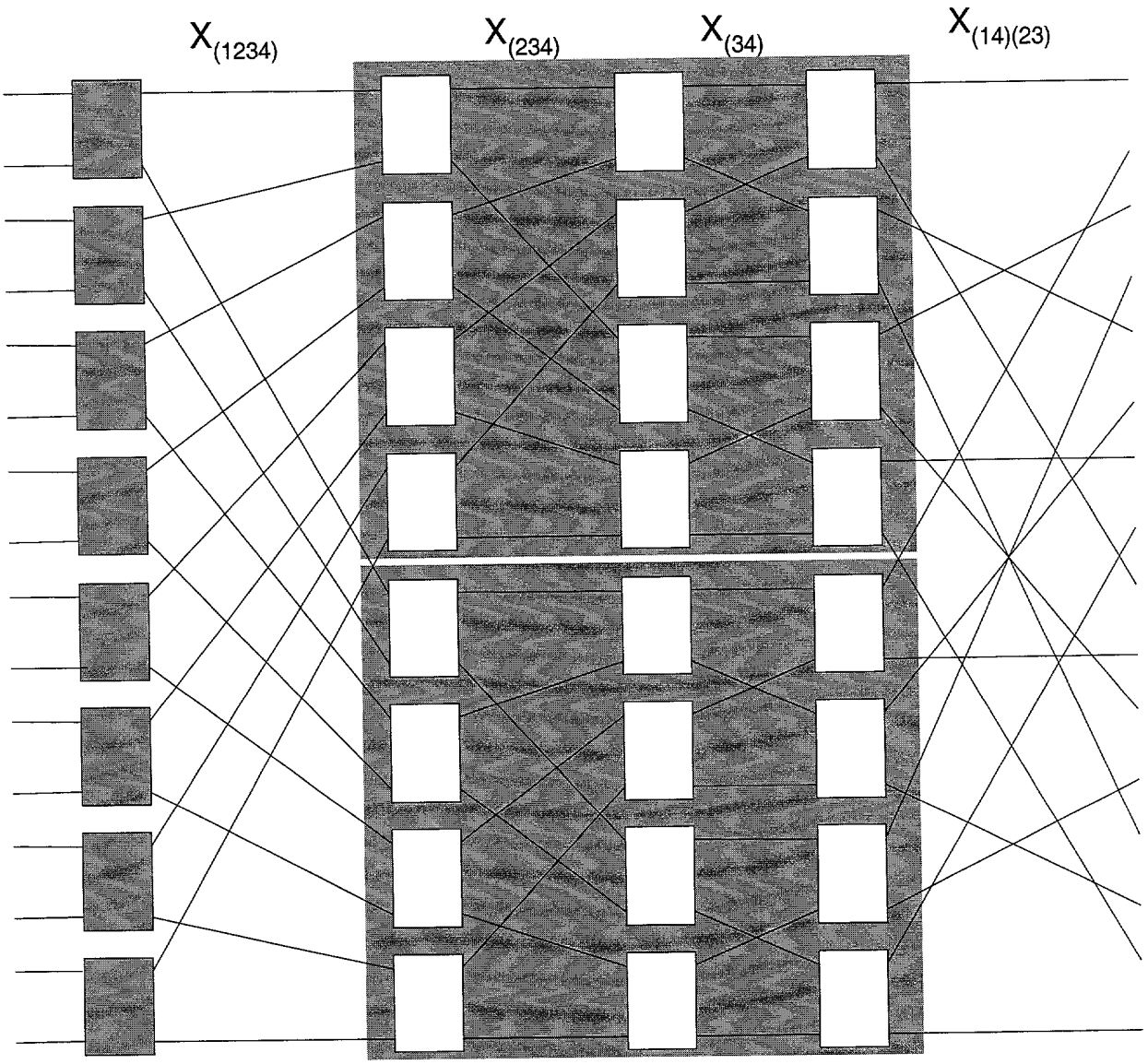


FIG. 54

5500

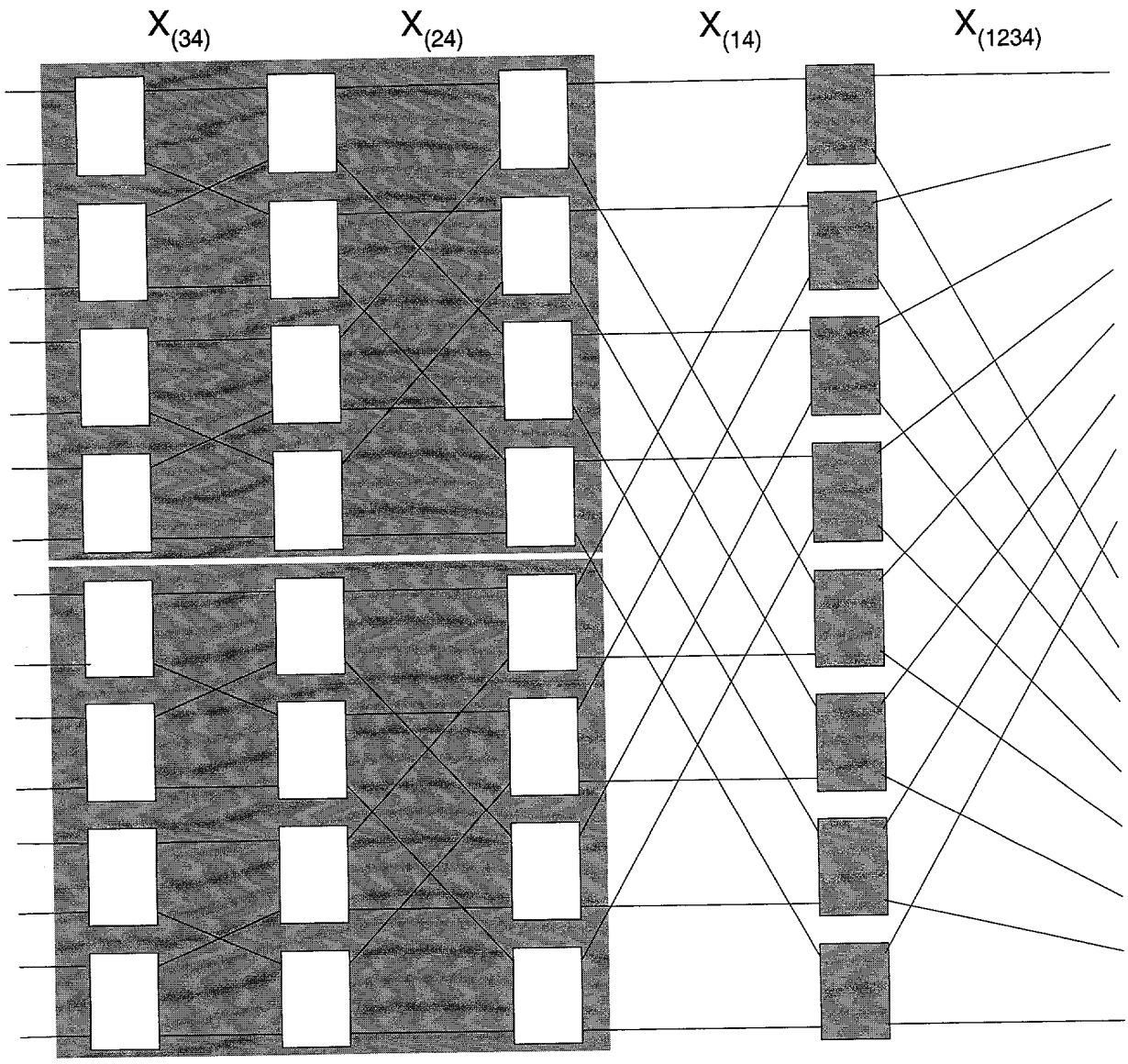


FIG. 55

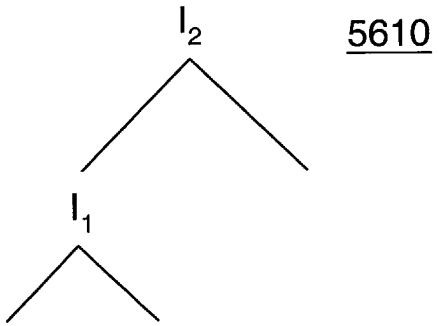


FIG. 56A

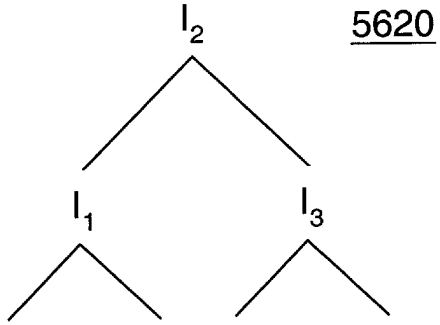


FIG. 56B

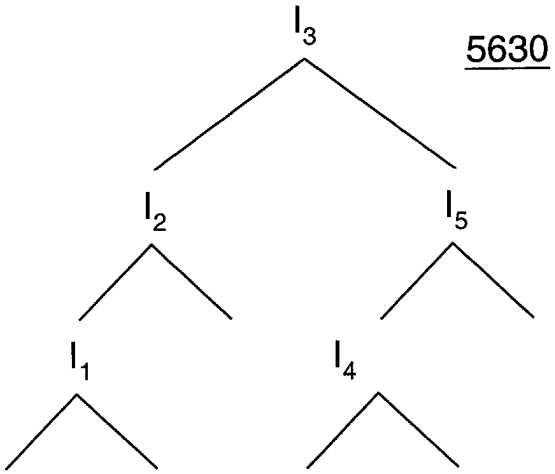


FIG. 56C

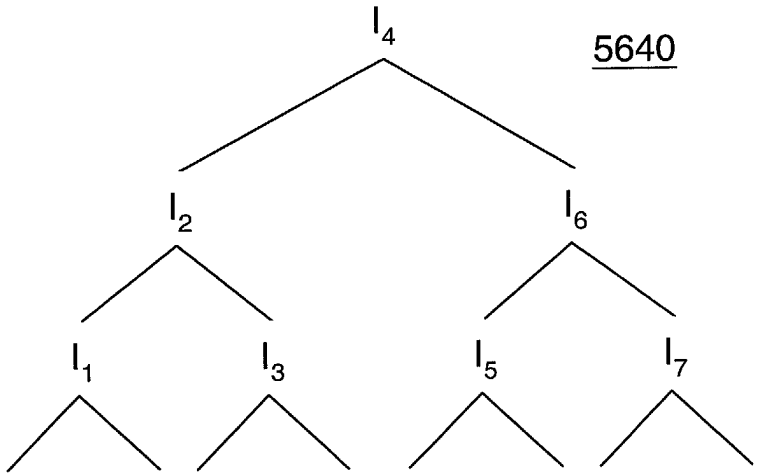


FIG. 56D

FIG. 57

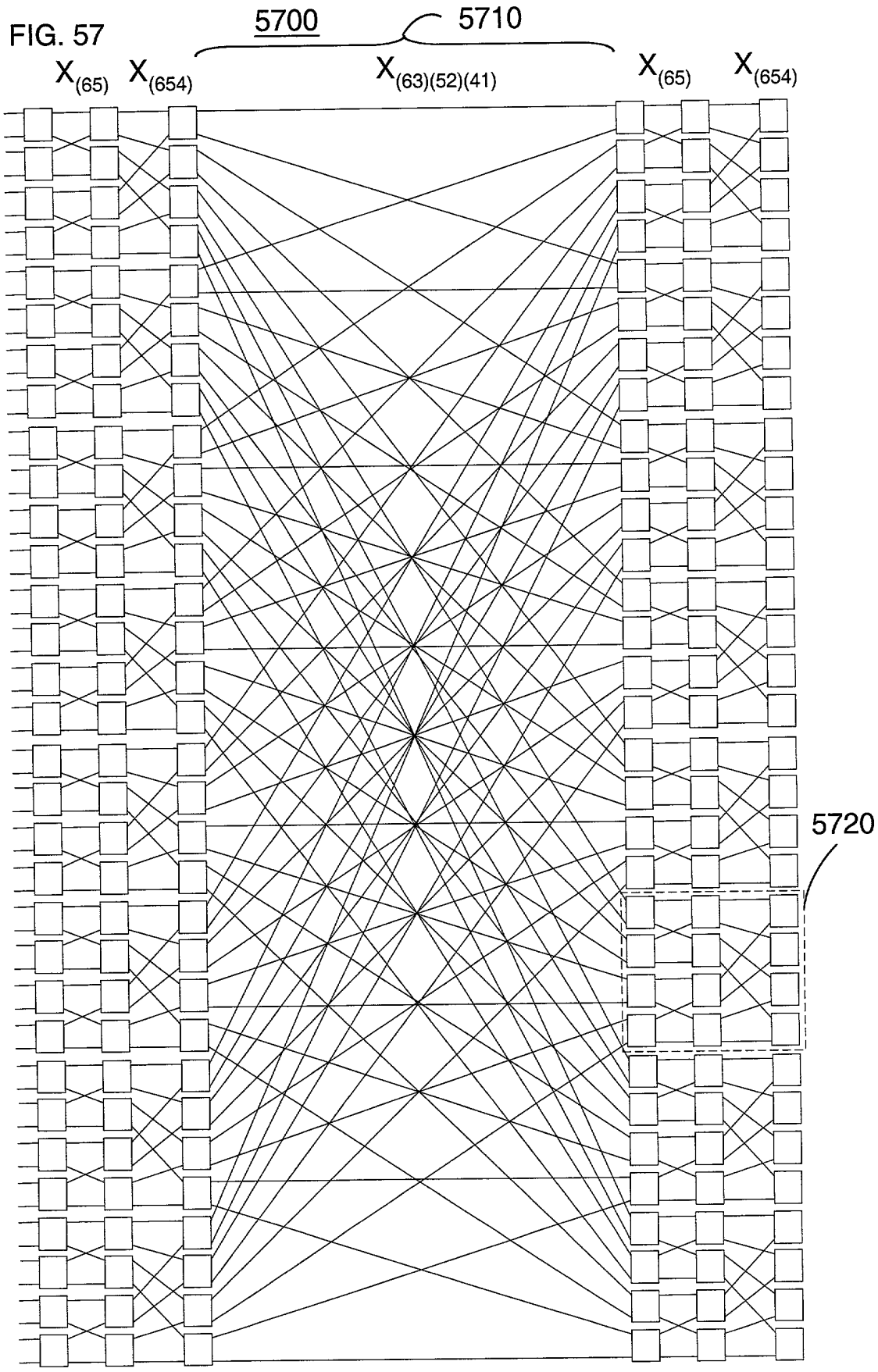


FIG. 58

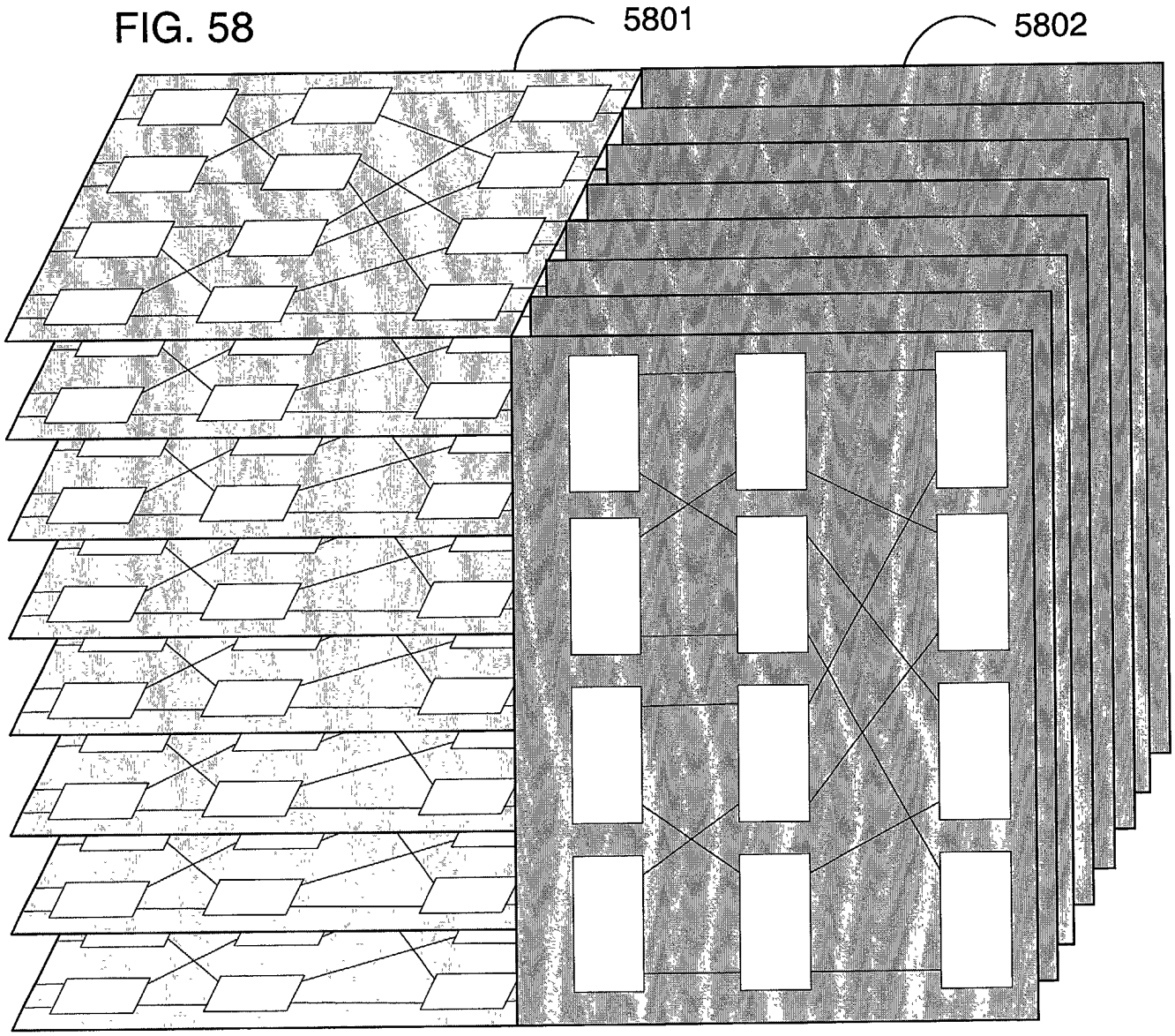
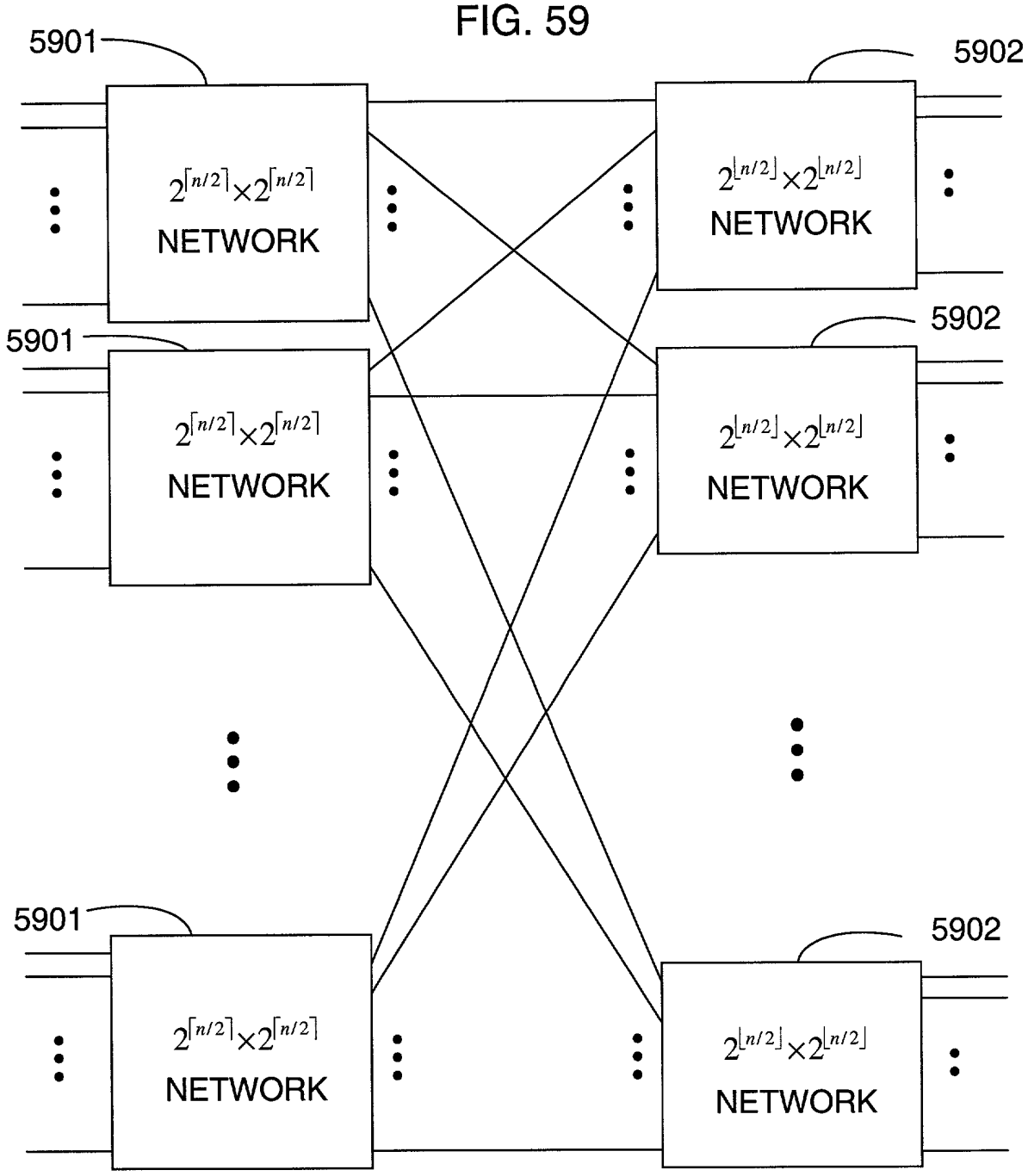


FIG. 59


5901
5902
$2^{\lceil n/2 \rceil} \times 2^{\lceil n/2 \rceil}$
NETWORK
$2^{\lfloor n/2 \rfloor} \times 2^{\lfloor n/2 \rfloor}$
NETWORK

6000

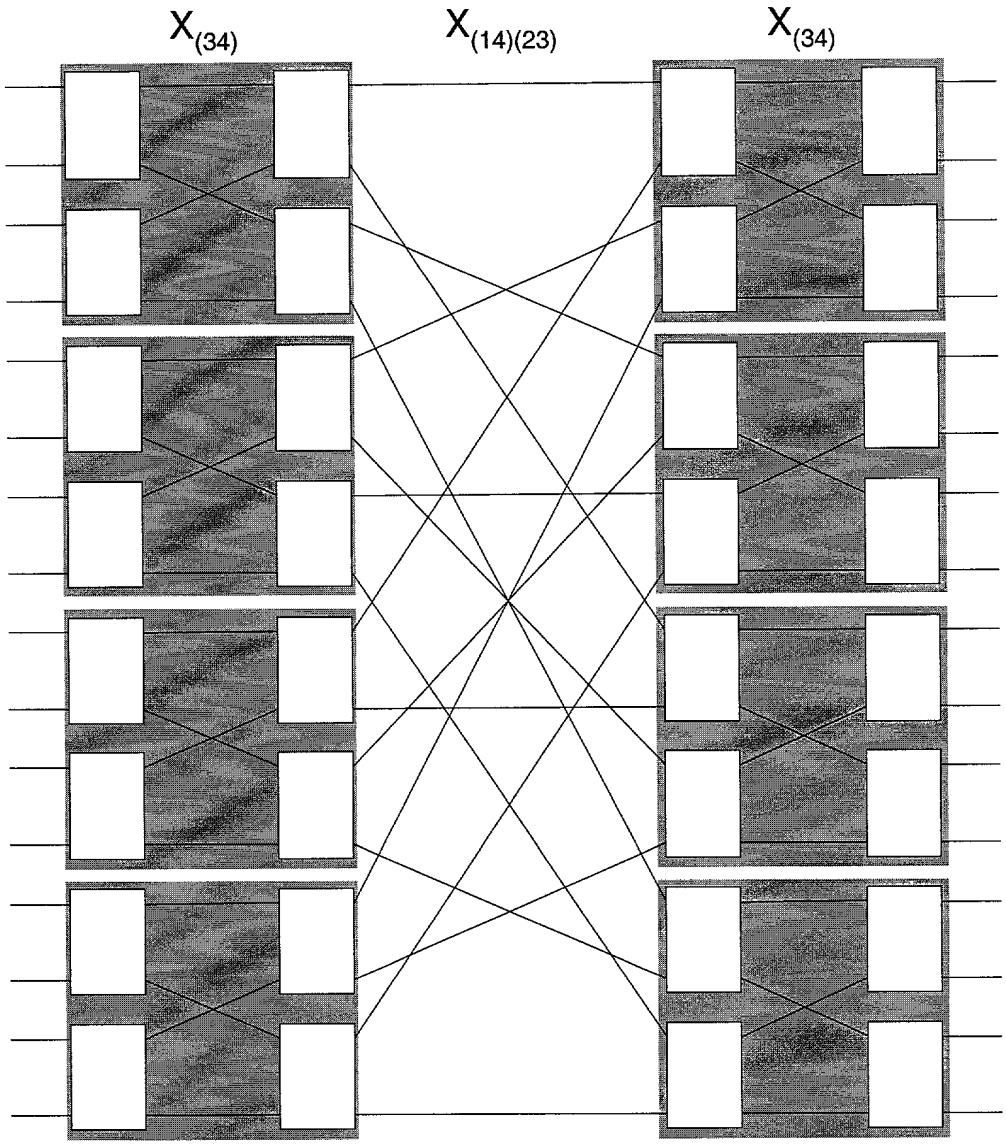
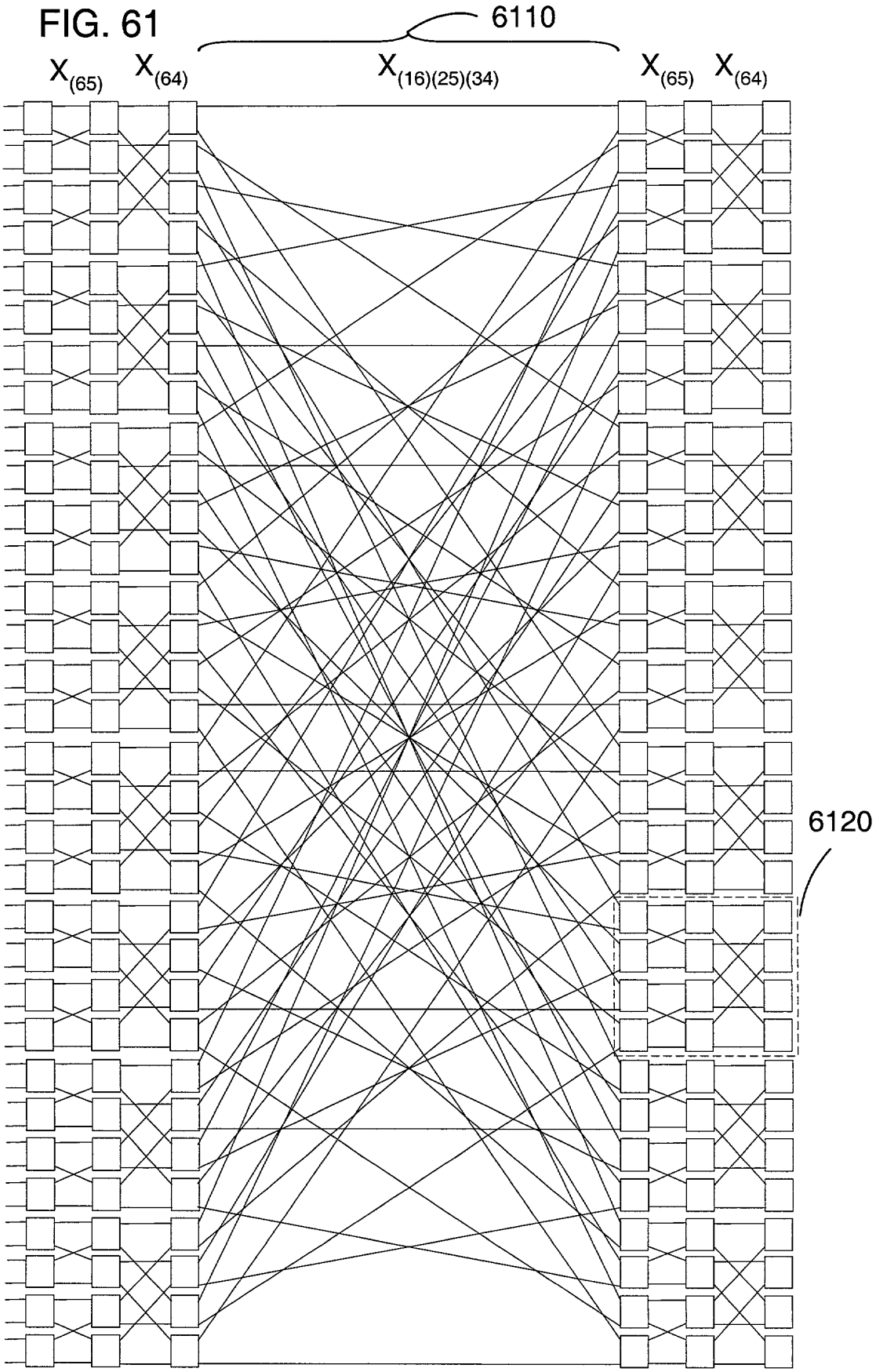


FIG. 60

FIG. 61



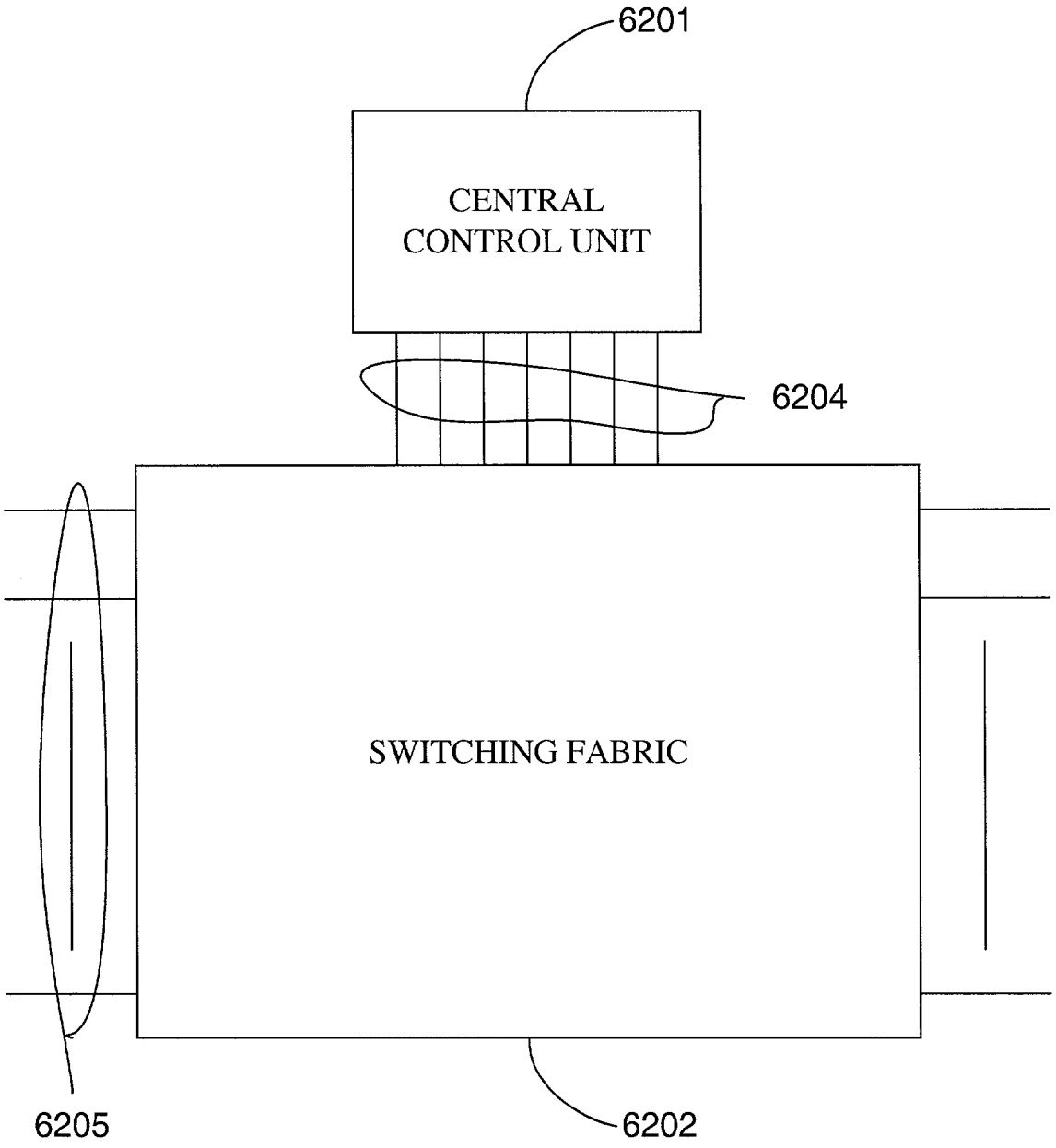


FIG. 62A

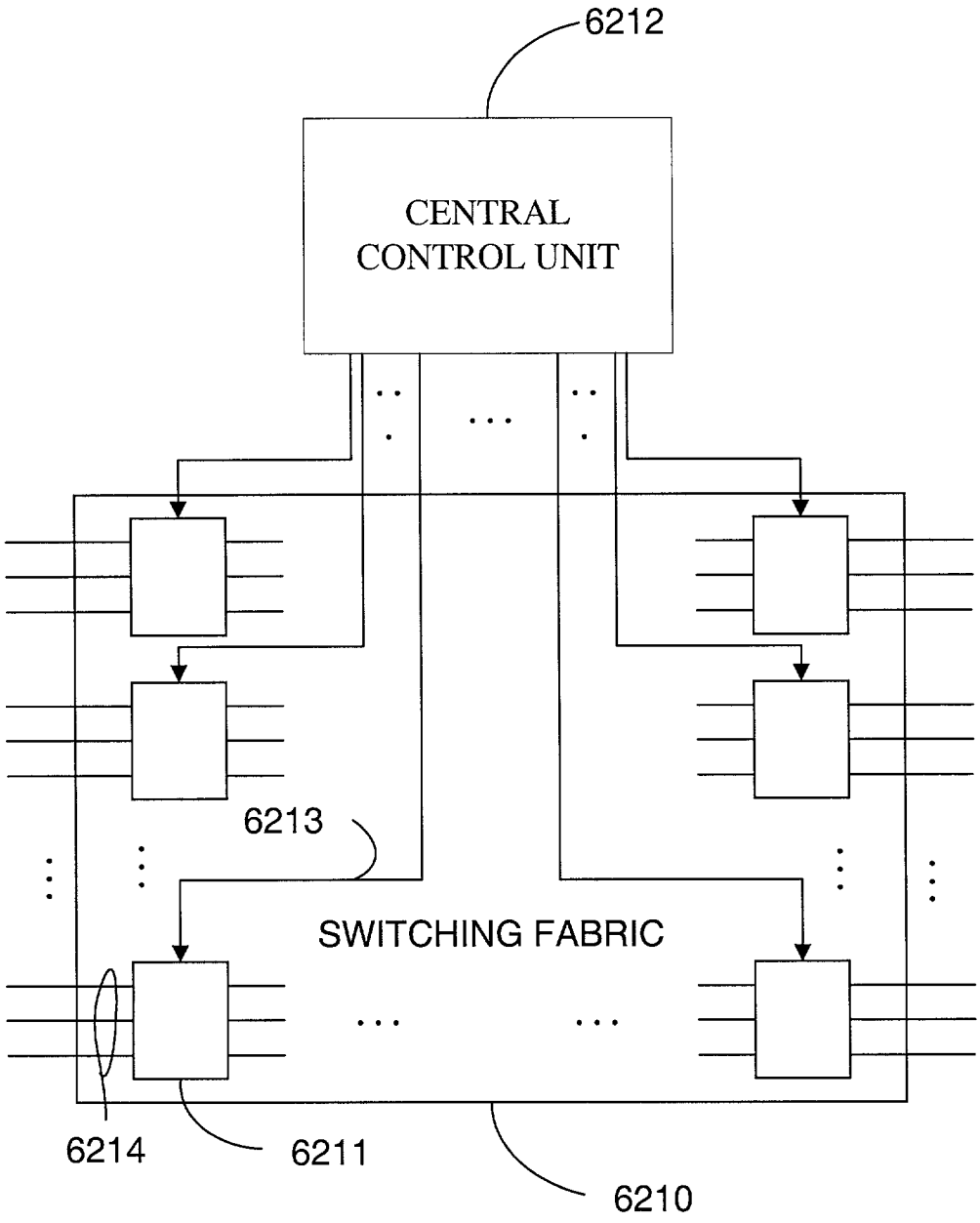

6212
CENTRAL
CONTROL UNIT
6213
SWITCHING FABRIC
6214
6211
6210

FIG. 62B

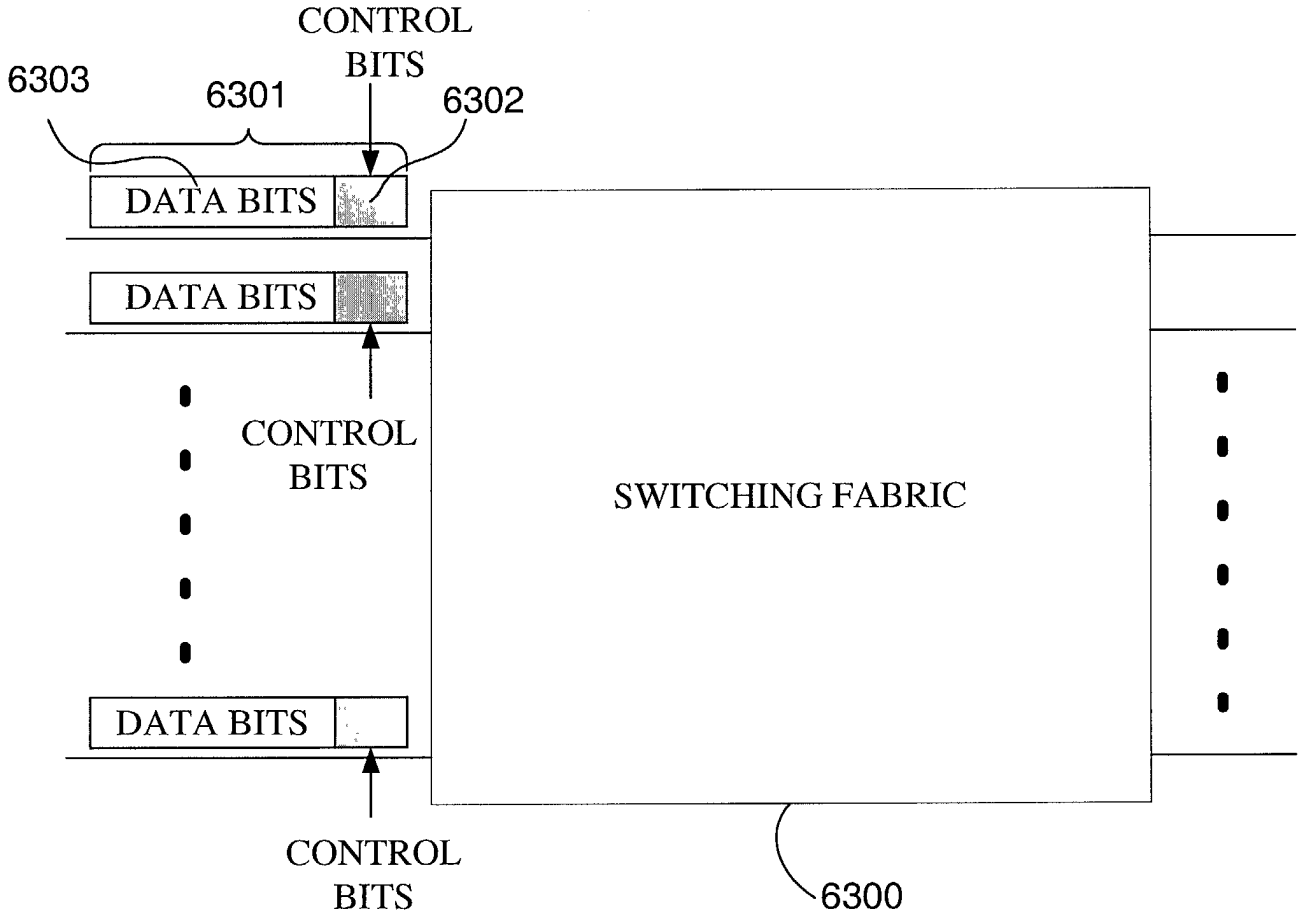

CONTROL
BITS
6303
6301
6302
DATA BITS
DATA BITS
CONTROL
BITS
SWITCHING FABRIC
DATA BITS
CONTROL
BITS
6300

FIG. 63A

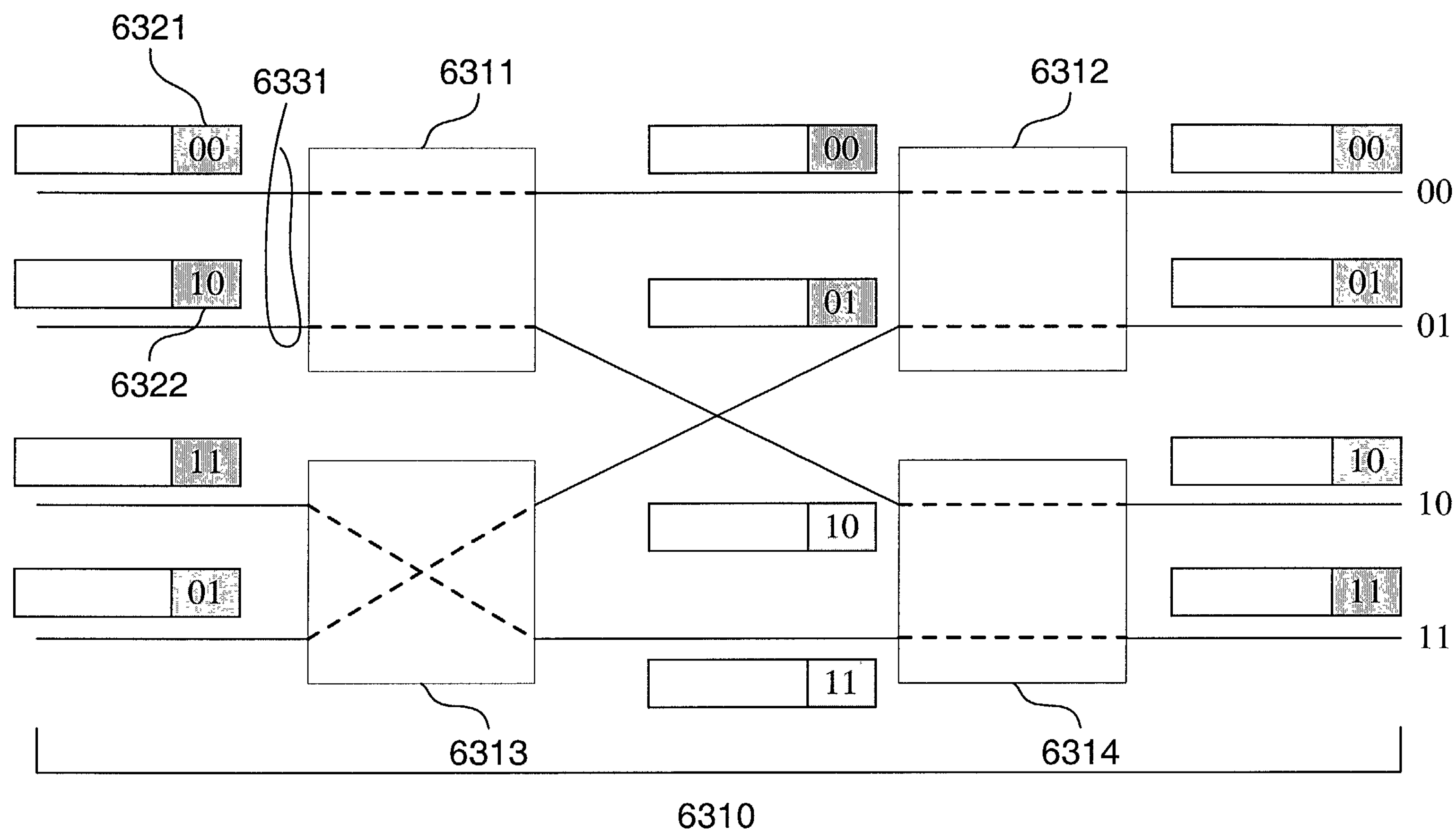


FIG. 63B

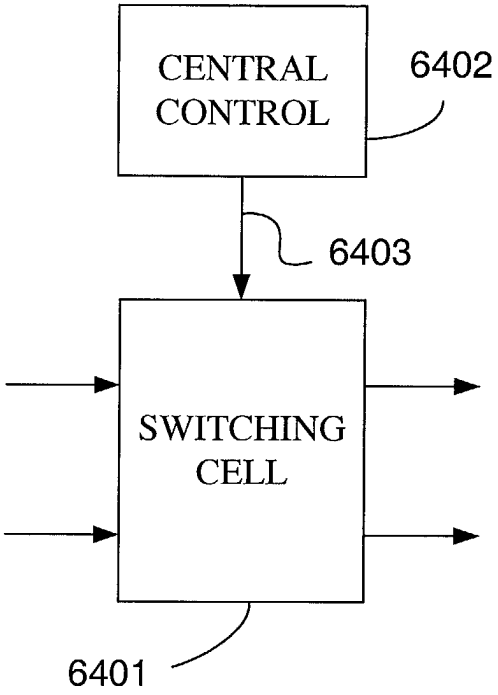


FIG. 64A

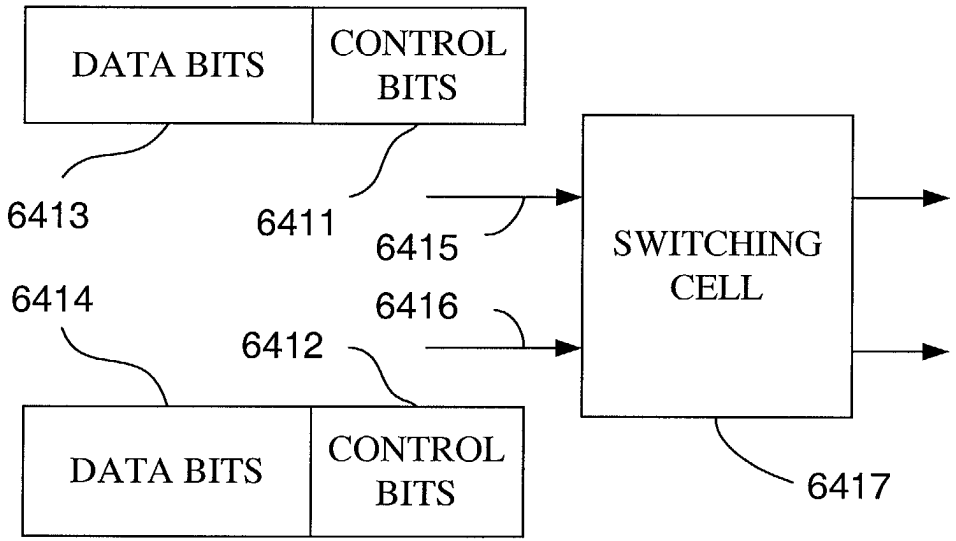


FIG. 64B

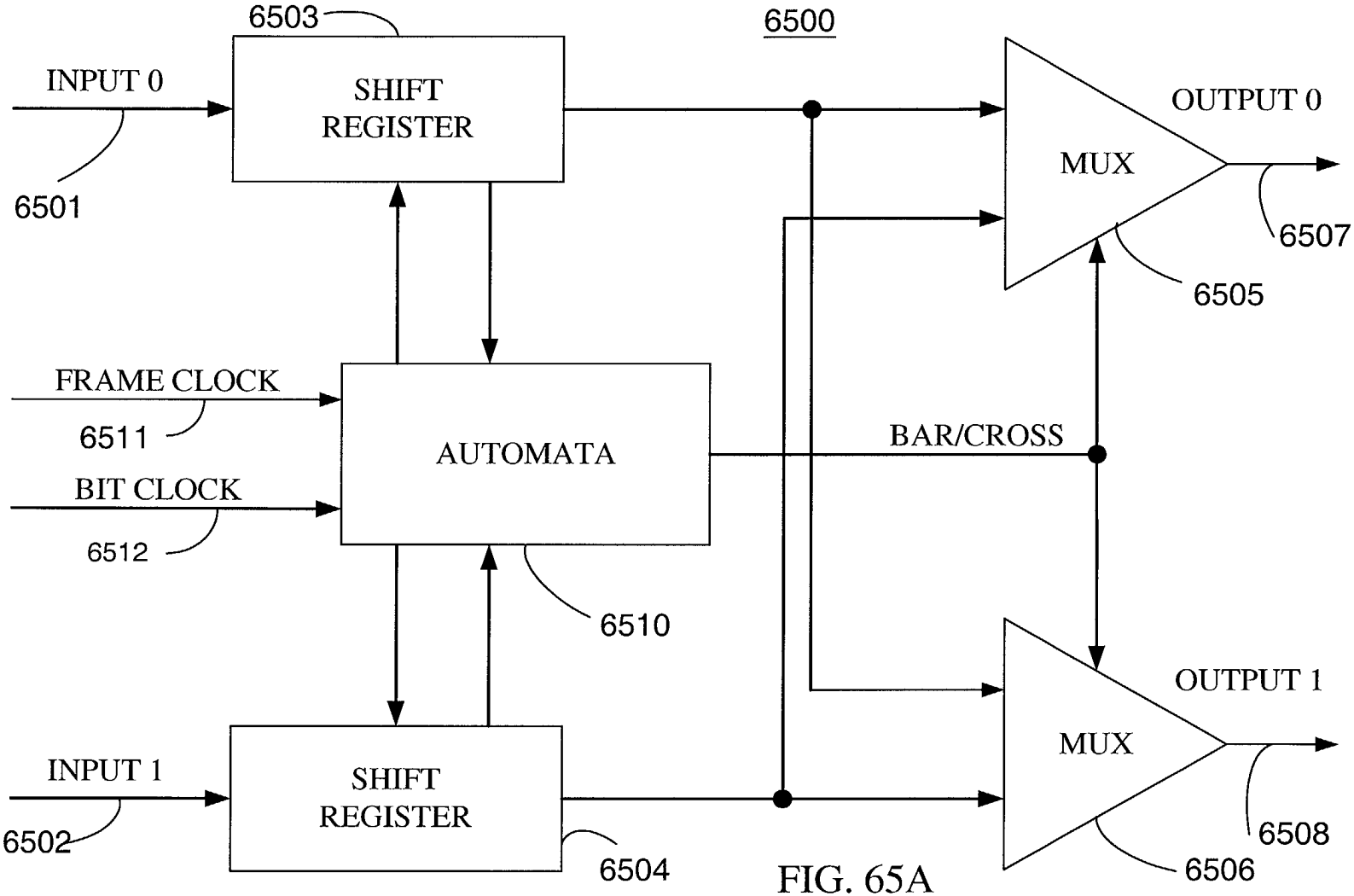

6503
6500
INPUT 0
SHIFT REGISTER
OUTPUT 0
MUX
6501
6507
6505
FRAME CLOCK
6511
AUTOMATA
BAR/CROSS
BIT CLOCK
6512
6510
OUTPUT 1
MUX
INPUT 1
SHIFT REGISTER
6502
6504
6508
6506

FIG. 65A

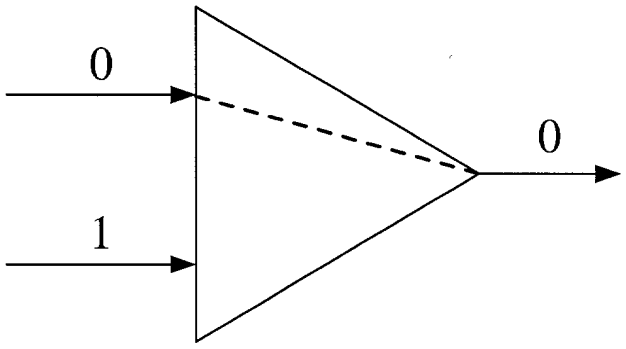


FIG. 65B

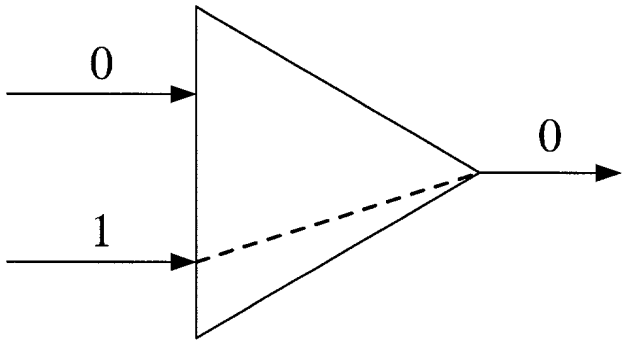


FIG. 65C

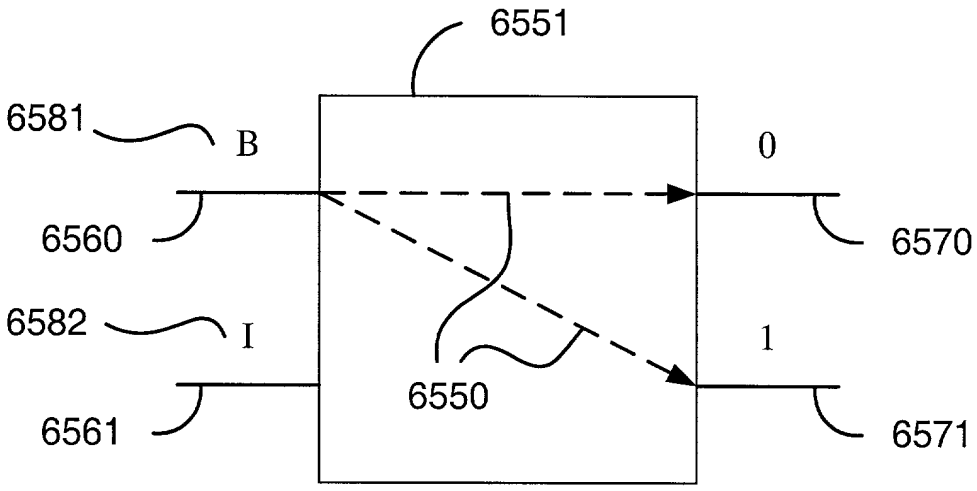


FIG. 65D

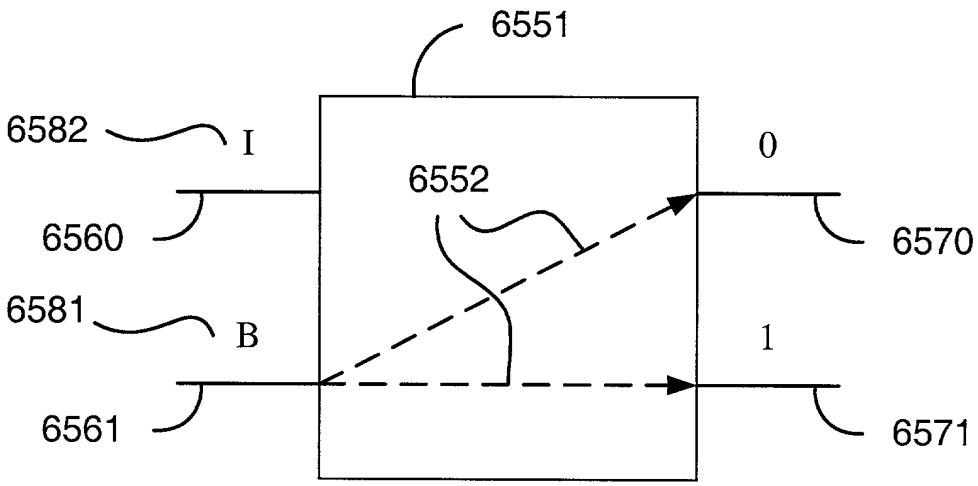


FIG. 65E

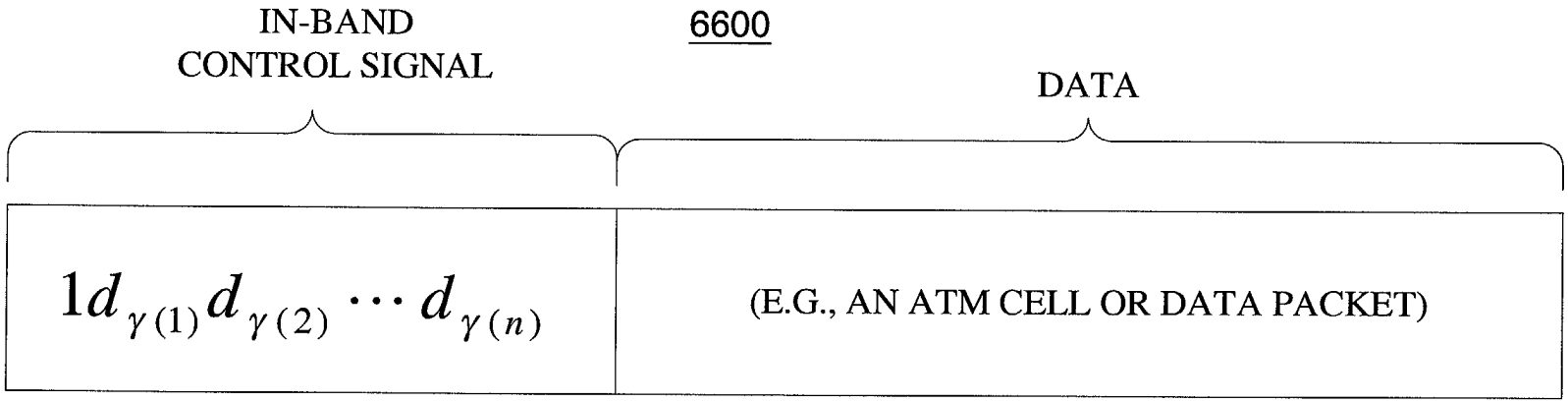


FIG. 66A

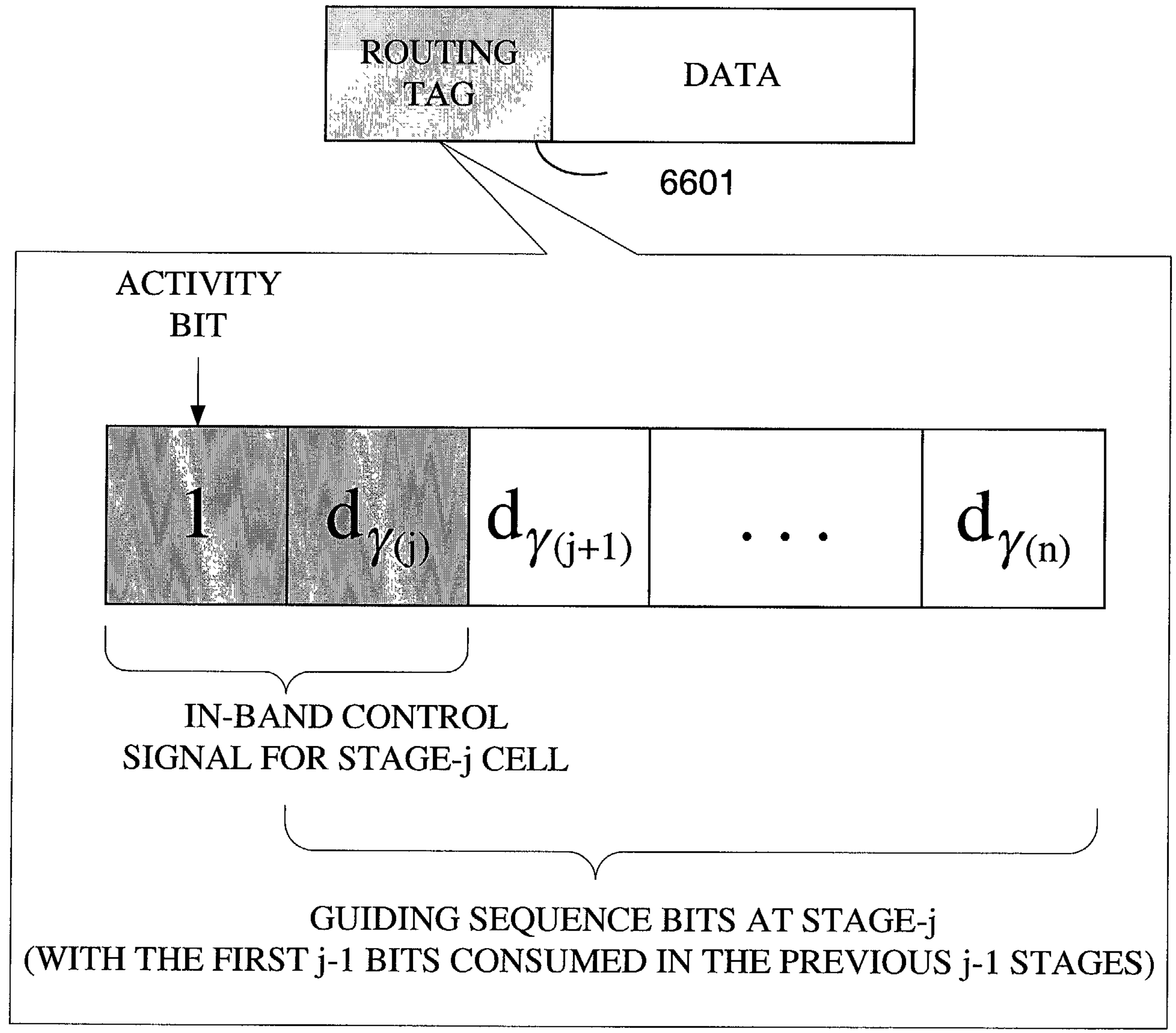

ROUTING TAG
DATA
6601
ACTIVITY BIT
1
$d_{\gamma(j)}$
$d_{\gamma(j+1)}$
. . .
$d_{\gamma(n)}$
IN-BAND CONTROL SIGNAL FOR STAGE-j CELL
GUIDING SEQUENCE BITS AT STAGE-j
(WITH THE FIRST j-1 BITS CONSUMED IN THE PREVIOUS j-1 STAGES)

FIG. 66B

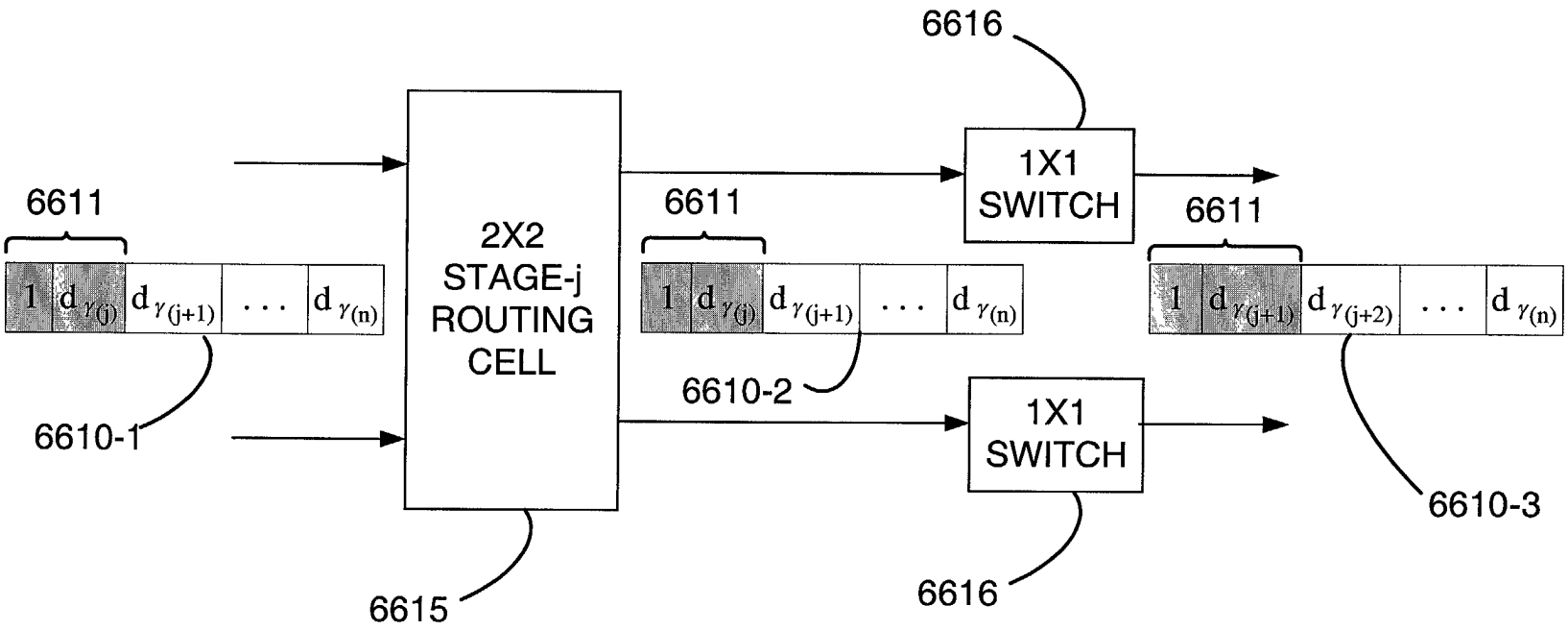


FIG. 66C

FIG. 66D

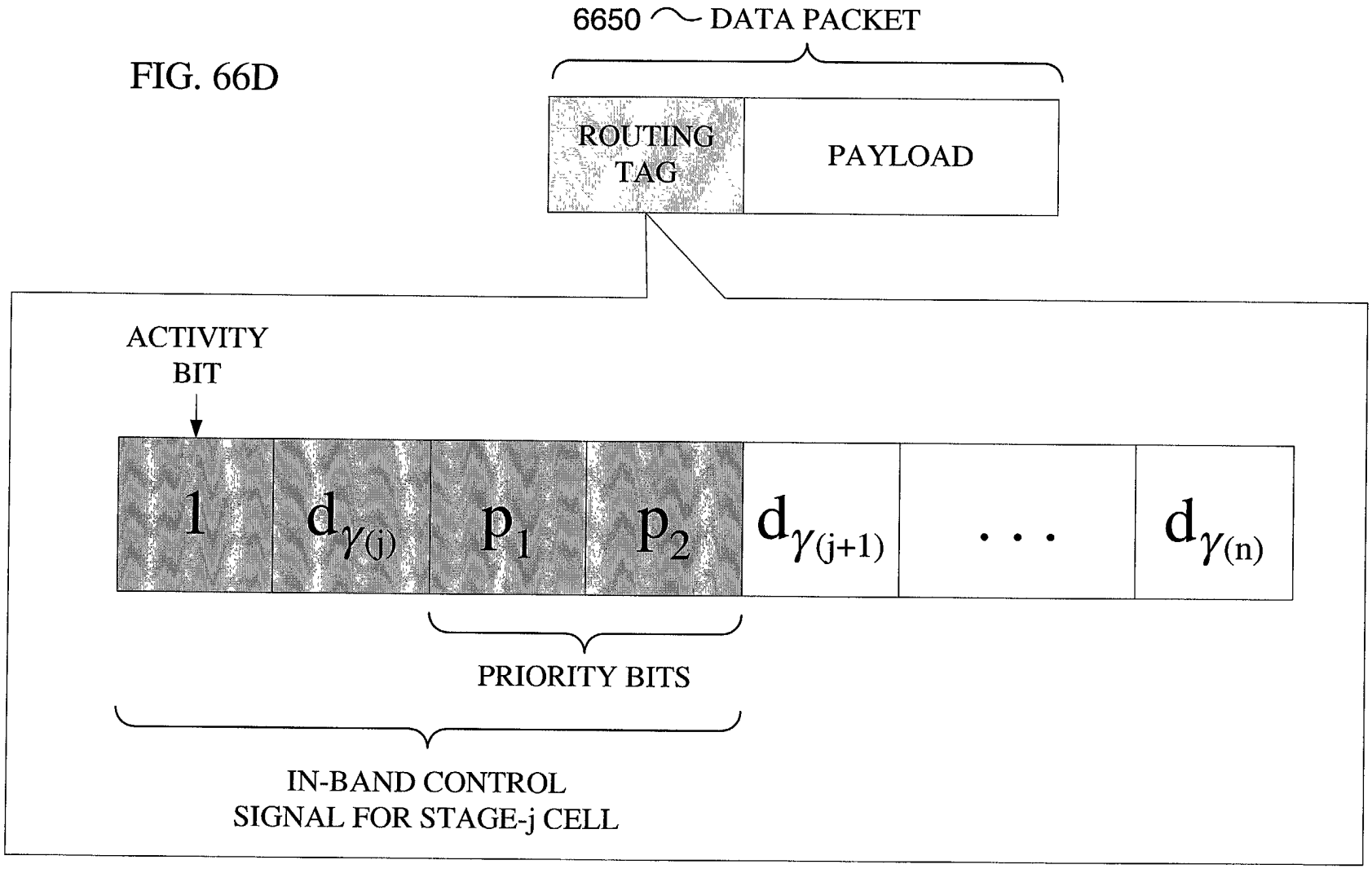


FIG. 67A

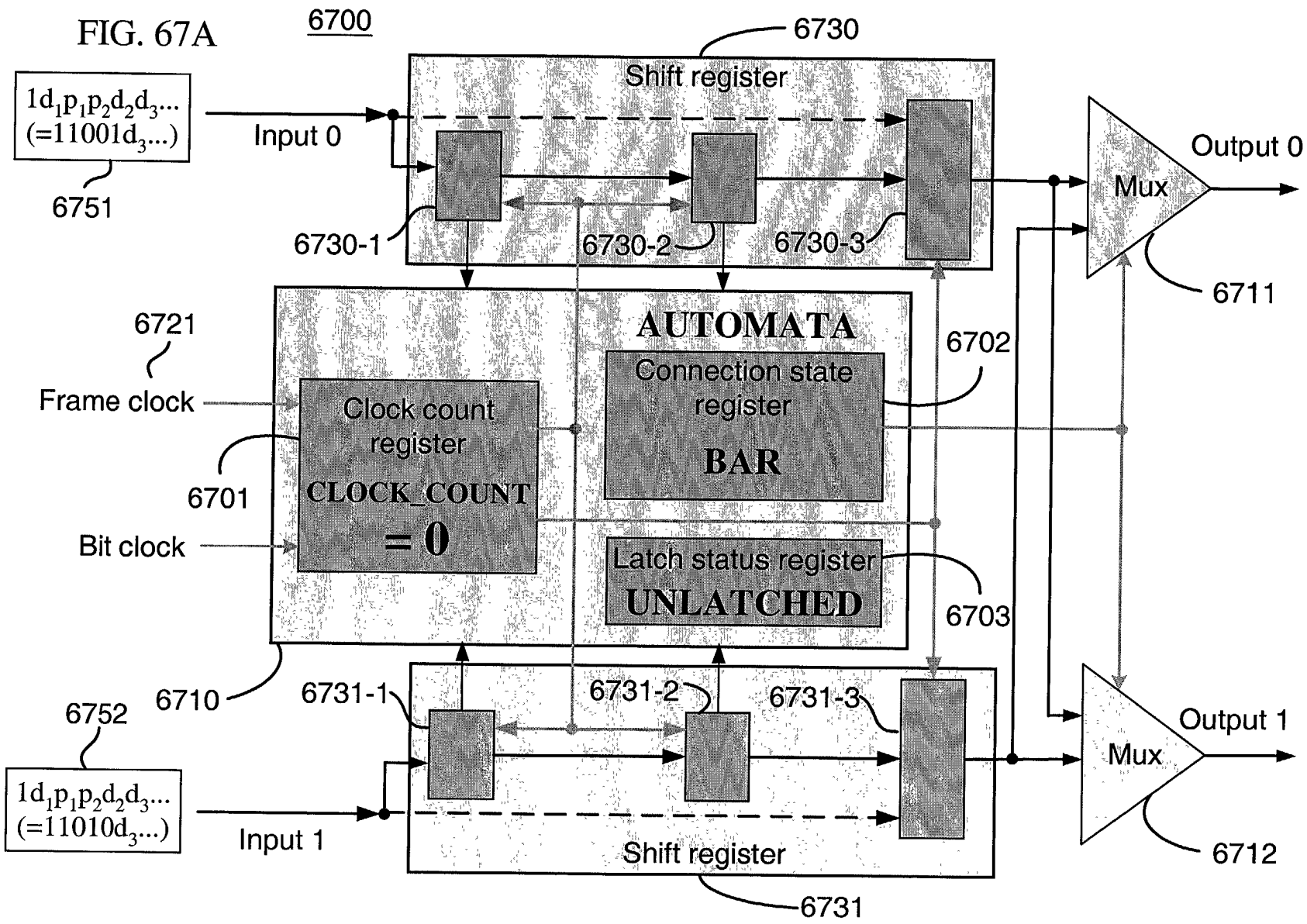

6700
6730
Shift register
$1d_1p_1p_2d_2d_3...$
$(=11001d_3...)$
Input 0
6751
6730-1
6730-2
6730-3
Output 0
Mux
6711
6721
Frame clock
AUTOMATA
6702
Connection state register
BAR
Clock count register
CLOCK_COUNT
= 0
6701
Bit clock
Latch status register
UNLATCHED
6703
6710
6731-1
6731-2
6731-3
6752
Output 1
Mux
$1d_1p_1p_2d_2d_3...$
$(=11010d_3...)$
Input 1
Shift register
6731
6712

FIG. 67B

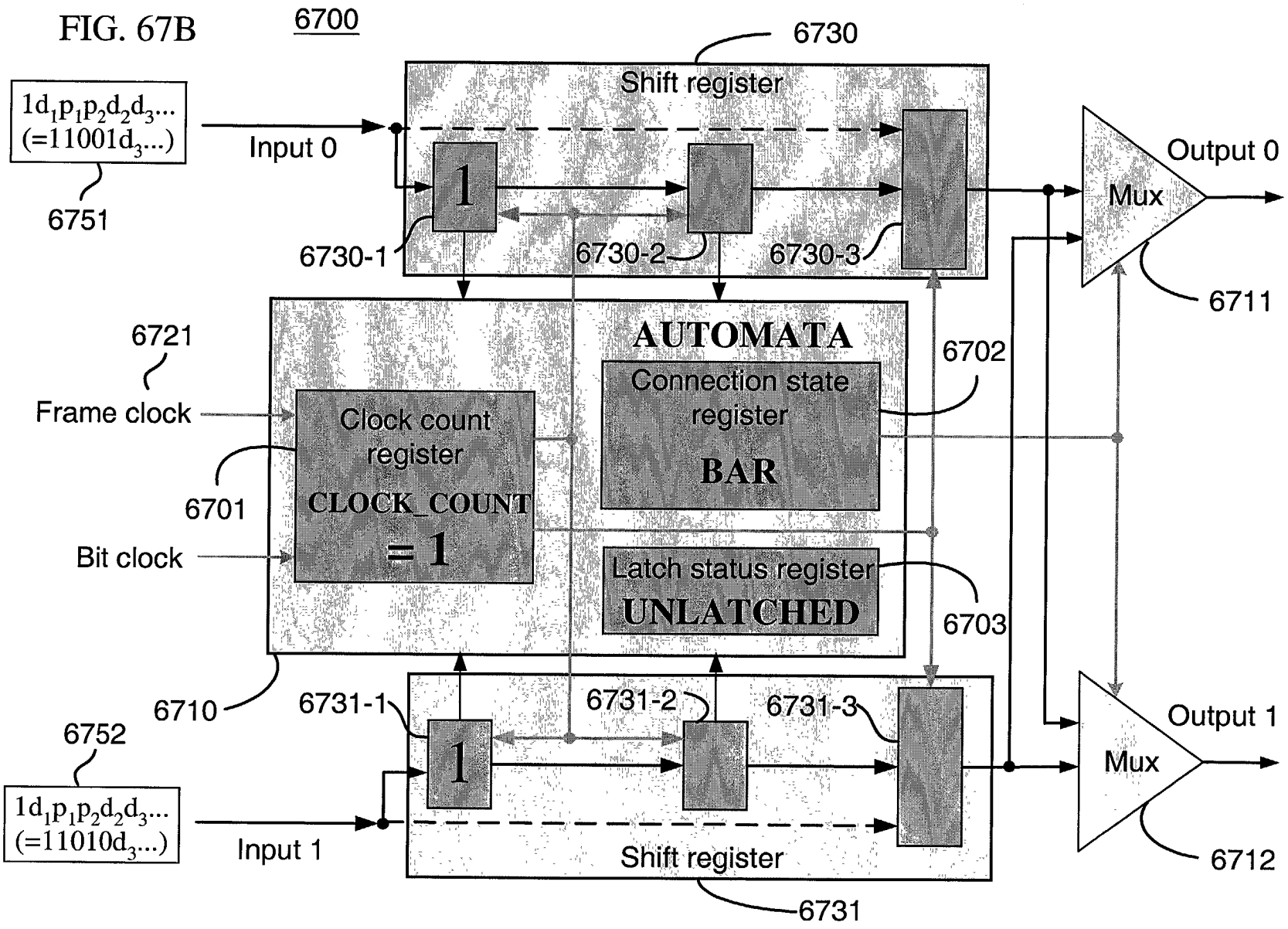

6700
6730
Shift register
$1d_1p_1p_2d_2d_3...$
$(=11001d_3...)$
6751
Input 0
1
6730-1
6730-2
6730-3
Output 0
Mux
6711
6721
Frame clock
AUTOMATA
6702
Connection state register
BAR
Clock count register
CLOCK_COUNT
= 1
6701
Bit clock
Latch status register
UNLATCHED
6703
6710
6731-1
6731-2
6731-3
6752
$1d_1p_1p_2d_2d_3...$
$(=11010d_3...)$
Input 1
1
Output 1
Mux
6712
Shift register
6731

FIG. 67C

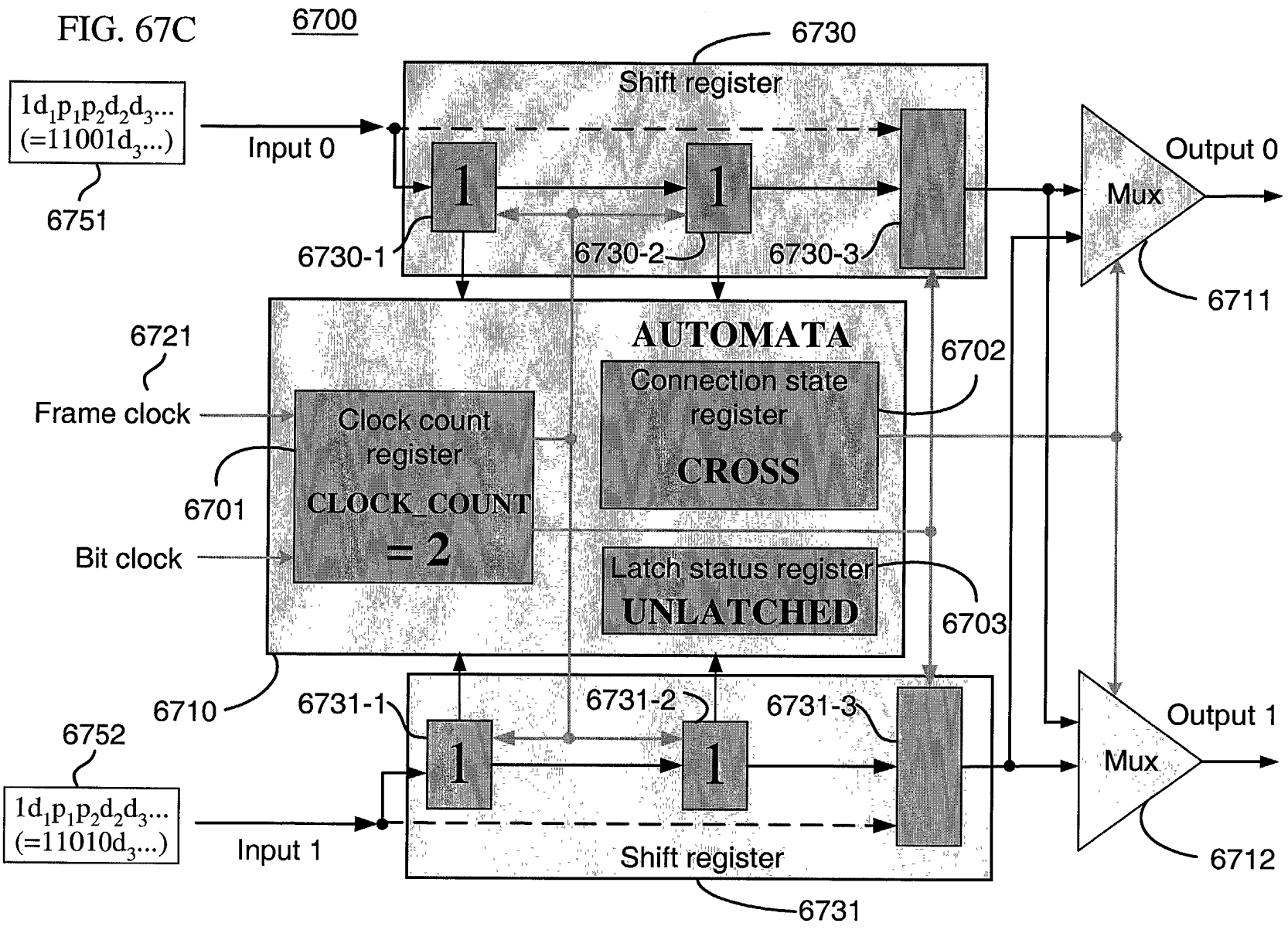

6700
6730
Shift register
$1d_1p_1p_2d_2d_3...$
$(=11001d_3...)$
6751
Input 0
1
1
6730-1
6730-2
6730-3
Output 0
Mux
6711
6721
Frame clock
AUTOMATA
6702
Connection state register
CROSS
Clock count register
CLOCK_COUNT
= 2
6701
Bit clock
Latch status register
UNLATCHED
6703
6710
6731-1
6731-2
6731-3
Output 1
6752
Mux
$1d_1p_1p_2d_2d_3...$
$(=11010d_3...)$
Input 1
Shift register
6731
6712

FIG. 67D

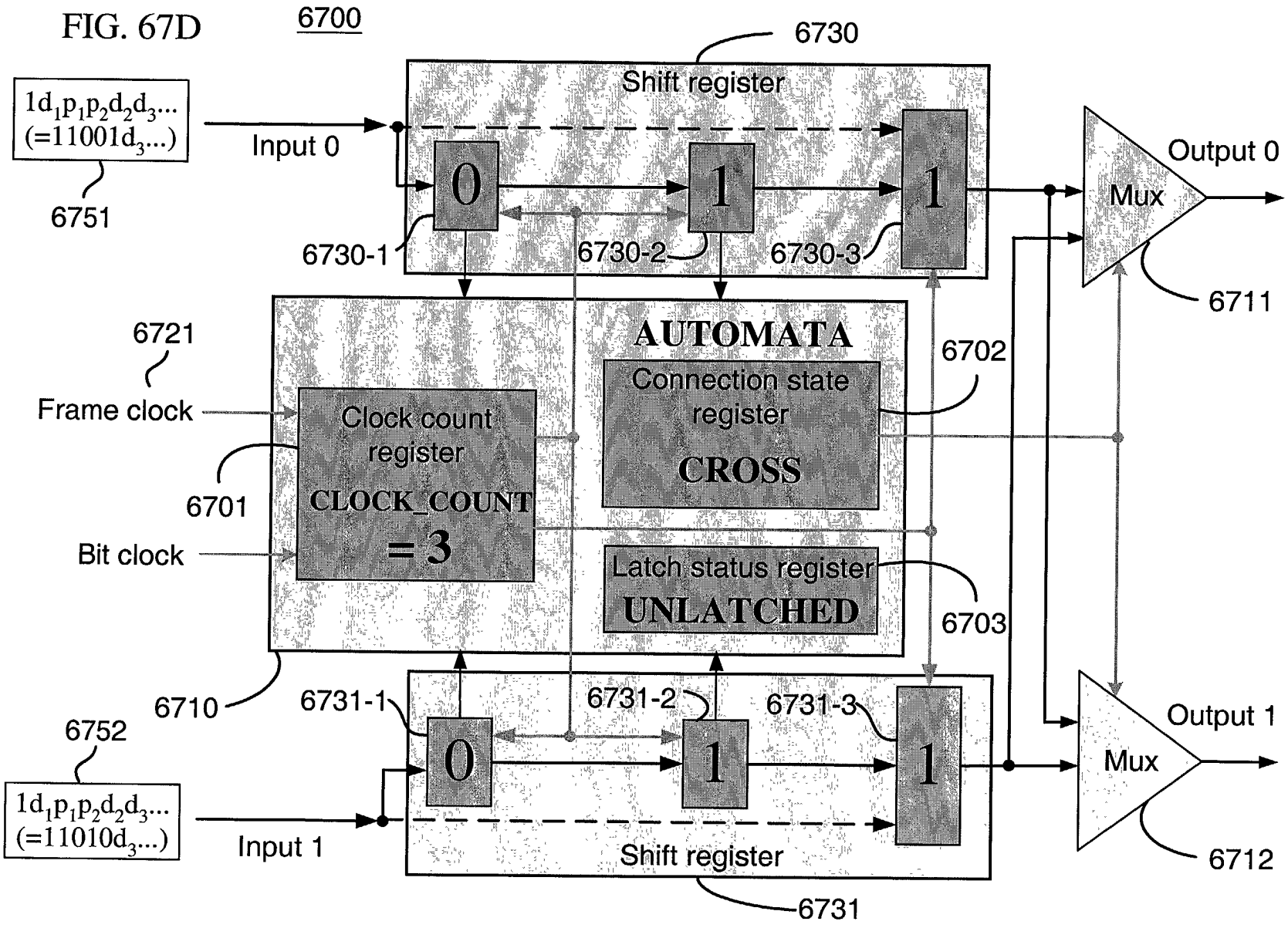
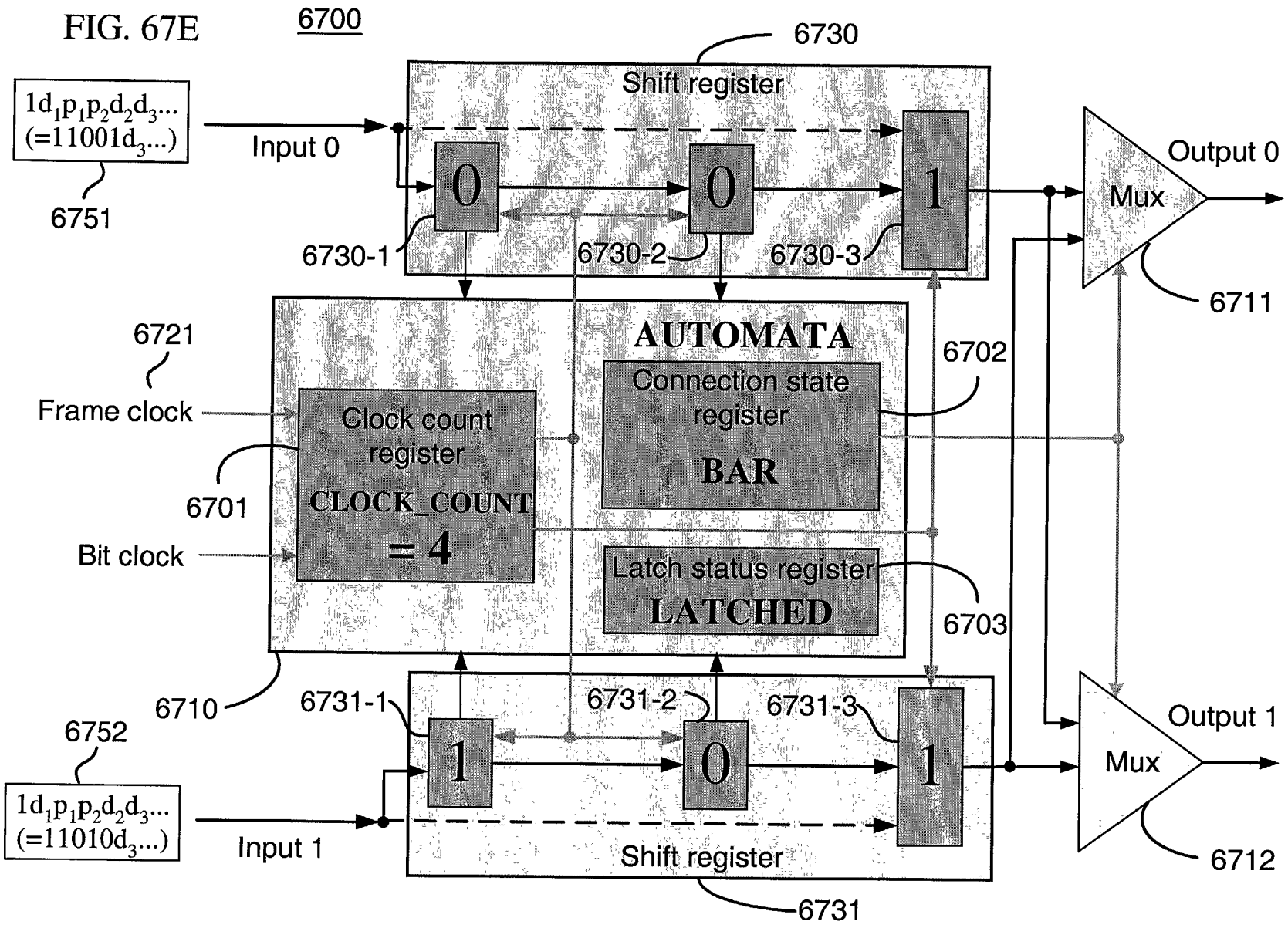

6700
6730
Shift register
$1d_1p_1p_2d_2d_3...$
$(=11001d_3...)$
Input 0
6751
0
1
1
6730-1
6730-2
6730-3
Output 0
Mux
6711
6721
Frame clock
AUTOMATA
6702
Connection state register
CROSS
Clock count register
CLOCK_COUNT
= 3
6701
Bit clock
Latch status register
UNLATCHED
6703
6710
6731-1
6731-2
6731-3
Output 1
Mux
6752
$1d_1p_1p_2d_2d_3...$
$(=11010d_3...)$
Input 1
0
1
1
Shift register
6731
6712

FIG. 67E


6700
6730
Shift register
1d1p1p2d2d3...
(=11001d3...)
6751
Input 0
0
0
1
6730-1
6730-2
6730-3
Output 0
Mux
6711
6721
Frame clock
AUTOMATA
6702
Connection state register
BAR
Clock count register
CLOCK_COUNT
= 4
6701
Bit clock
Latch status register
LATCHED
6703
6710
6731-1
6731-2
6731-3
Output 1
Mux
6712
6752
1d1p1p2d2d3...
(=11010d3...)
Input 1
1
0
1
Shift register
6731

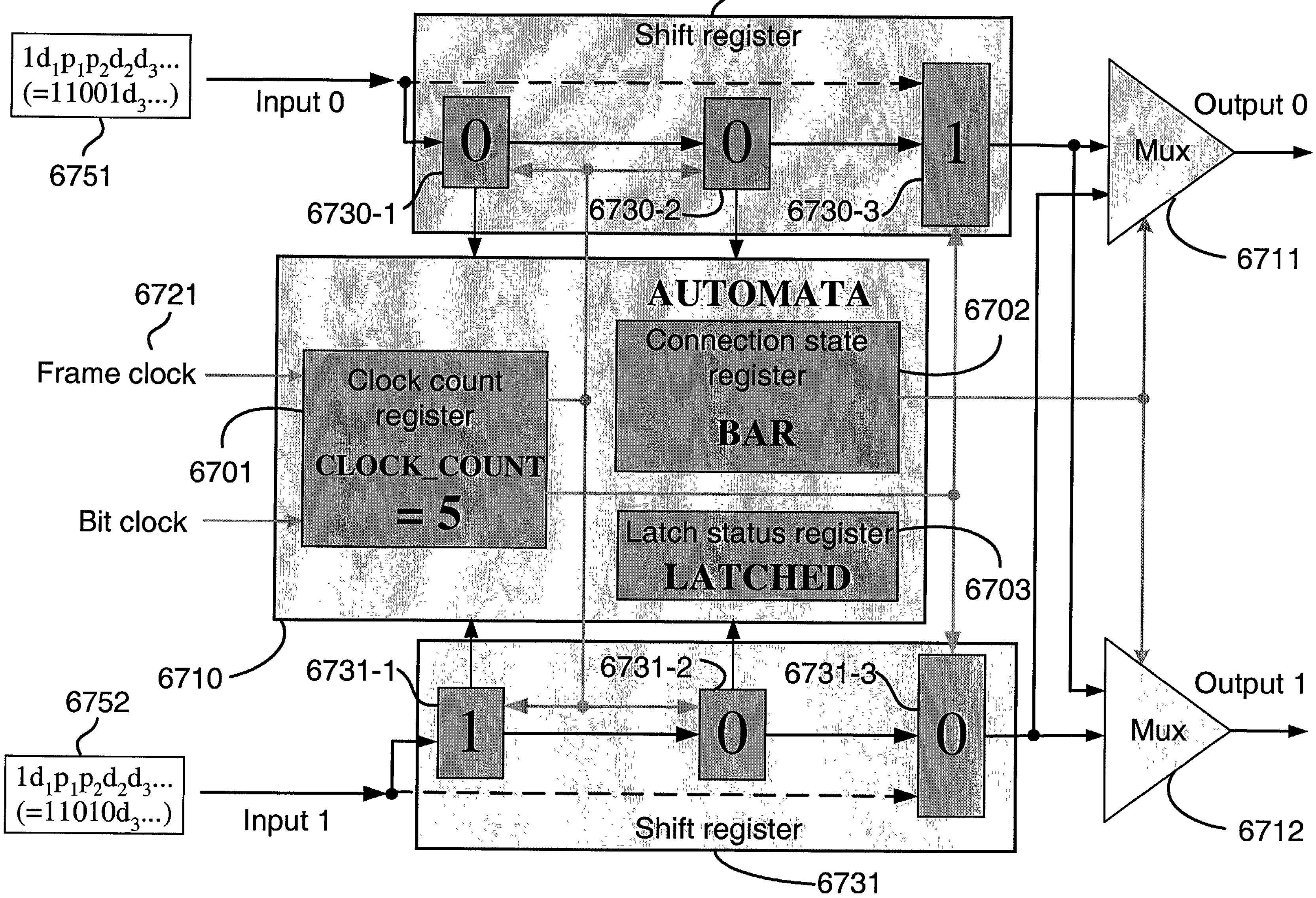

6700
6730
Shift register
1d₁p₁p₂d₂d₃...
(=11001d₃...)
Input 0
6751
0
0
1
6730-1
6730-2
6730-3
Output 0
Mux
6711
AUTOMATA
6721
Frame clock
Clock count register
CLOCK_COUNT
= 5
6701
Bit clock
Connection state register
BAR
6702
Latch status register
LATCHED
6703
6710
6752
1d₁p₁p₂d₂d₃...
(=11010d₃...)
Input 1
6731-1
6731-2
6731-3
1
0
0
Shift register
6731
Output 1
Mux
6712

FIG. 67F

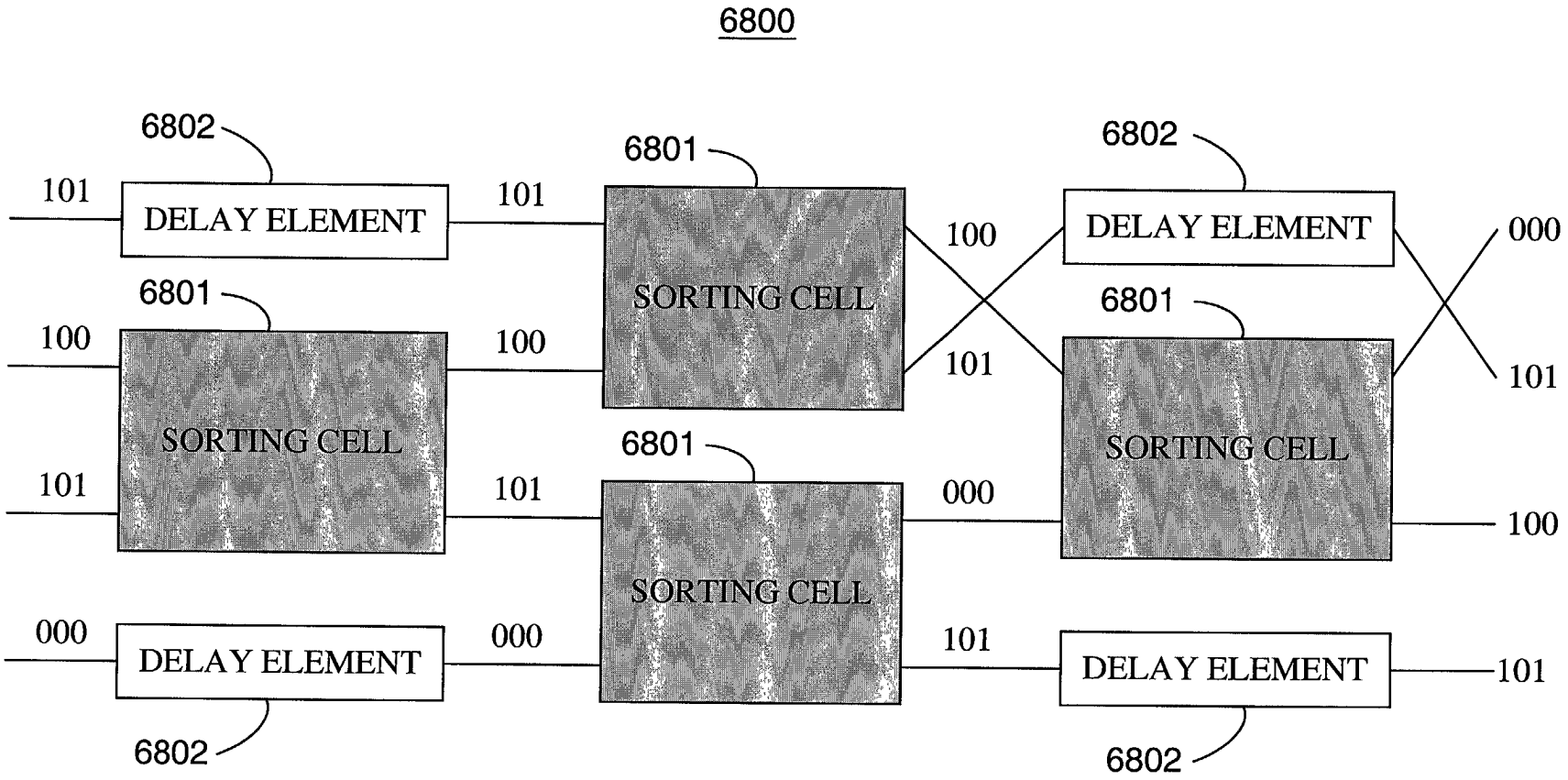
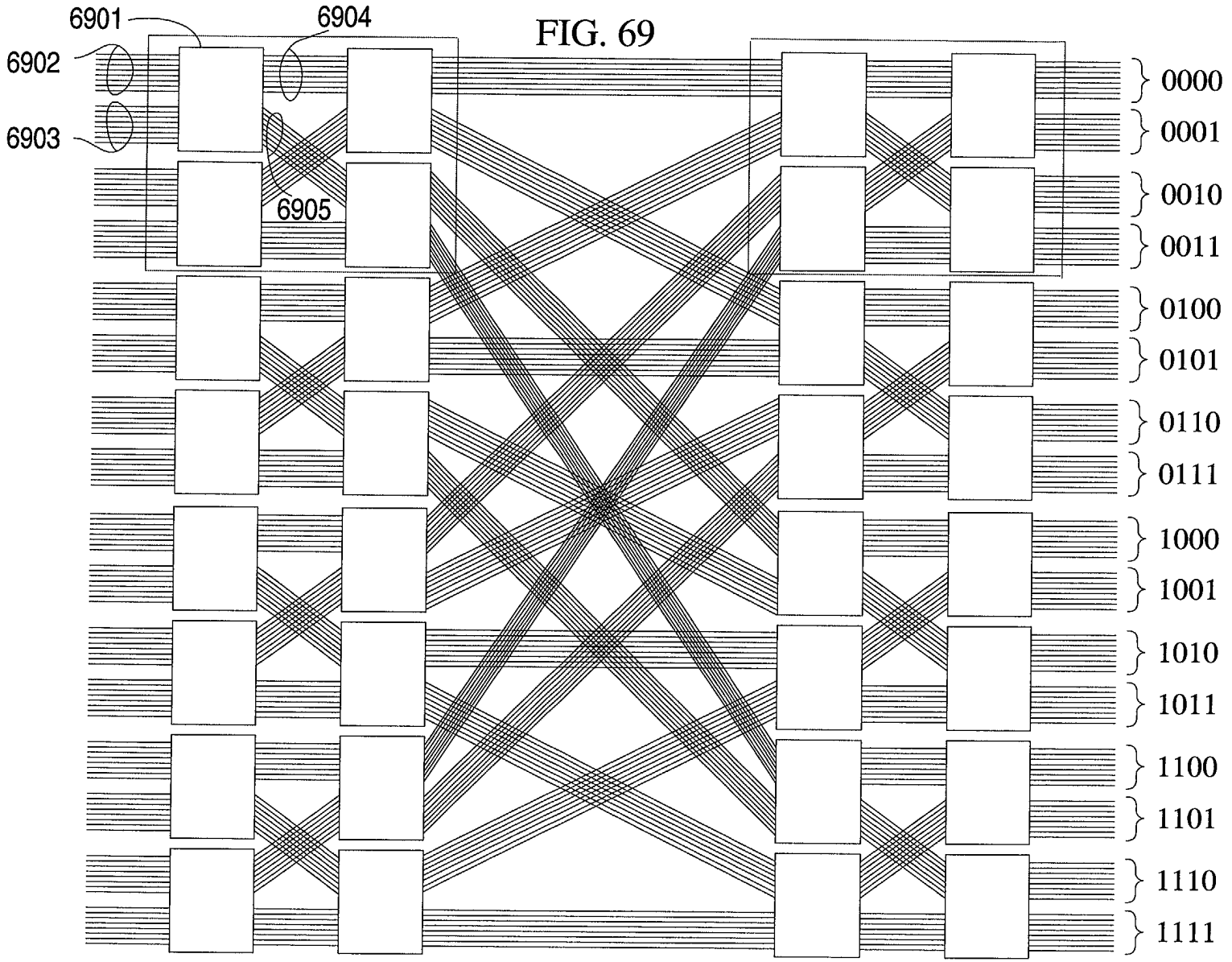

6800
6802
101
DELAY ELEMENT
101
6801
SORTING CELL
100
6802
DELAY ELEMENT
000
6801
100
SORTING CELL
100
101
6801
SORTING CELL
101
101
6801
SORTING CELL
000
100
000
DELAY ELEMENT
000
101
DELAY ELEMENT
101
6802
6802

FIG. 68

FIG. 69


6901
6904
6902
6903
6905
0000
0001
0010
0011
0100
0101
0110
0111
1000
1001
1010
1011
1100
1101
1110
1111

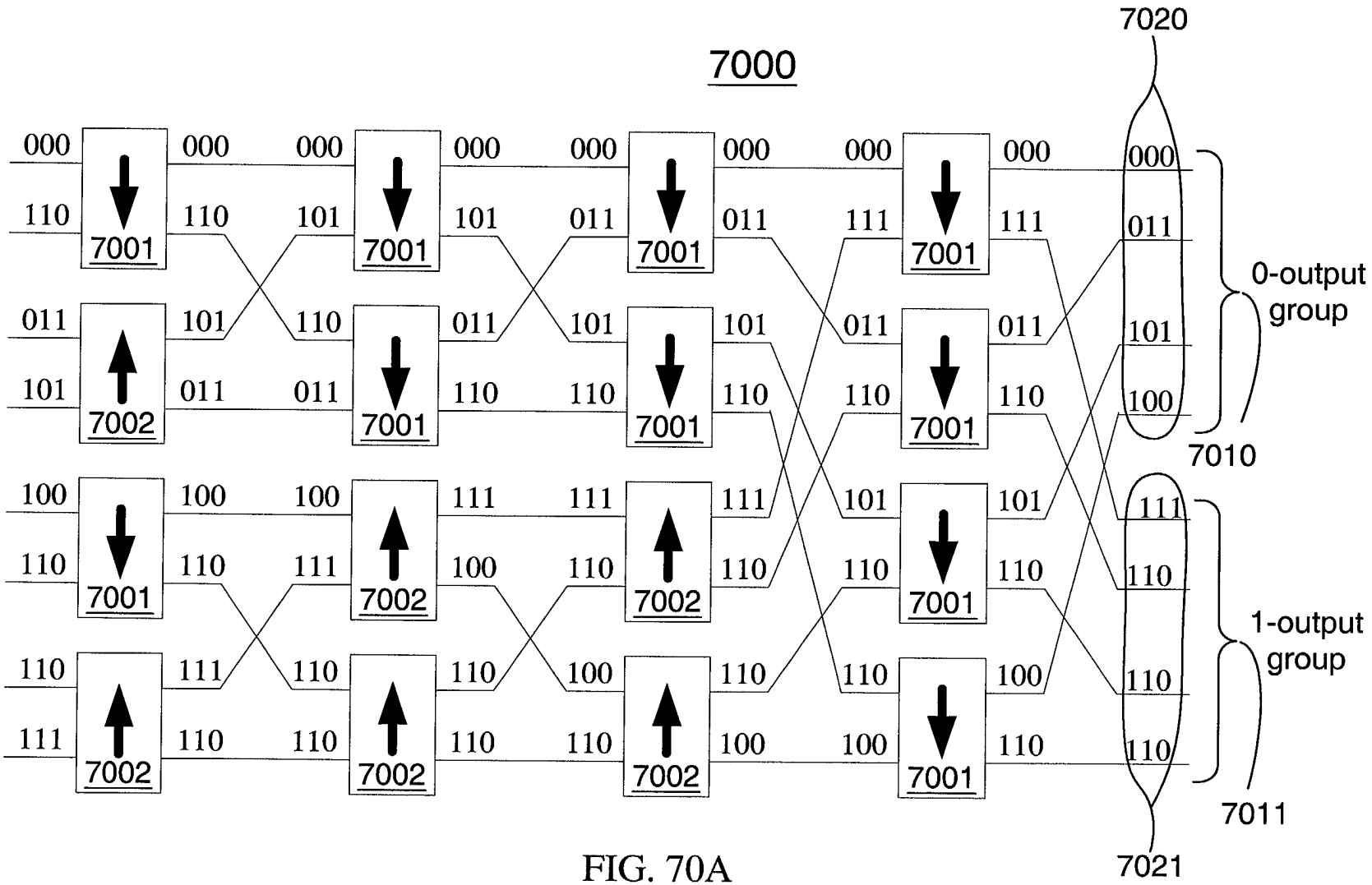


FIG. 70A

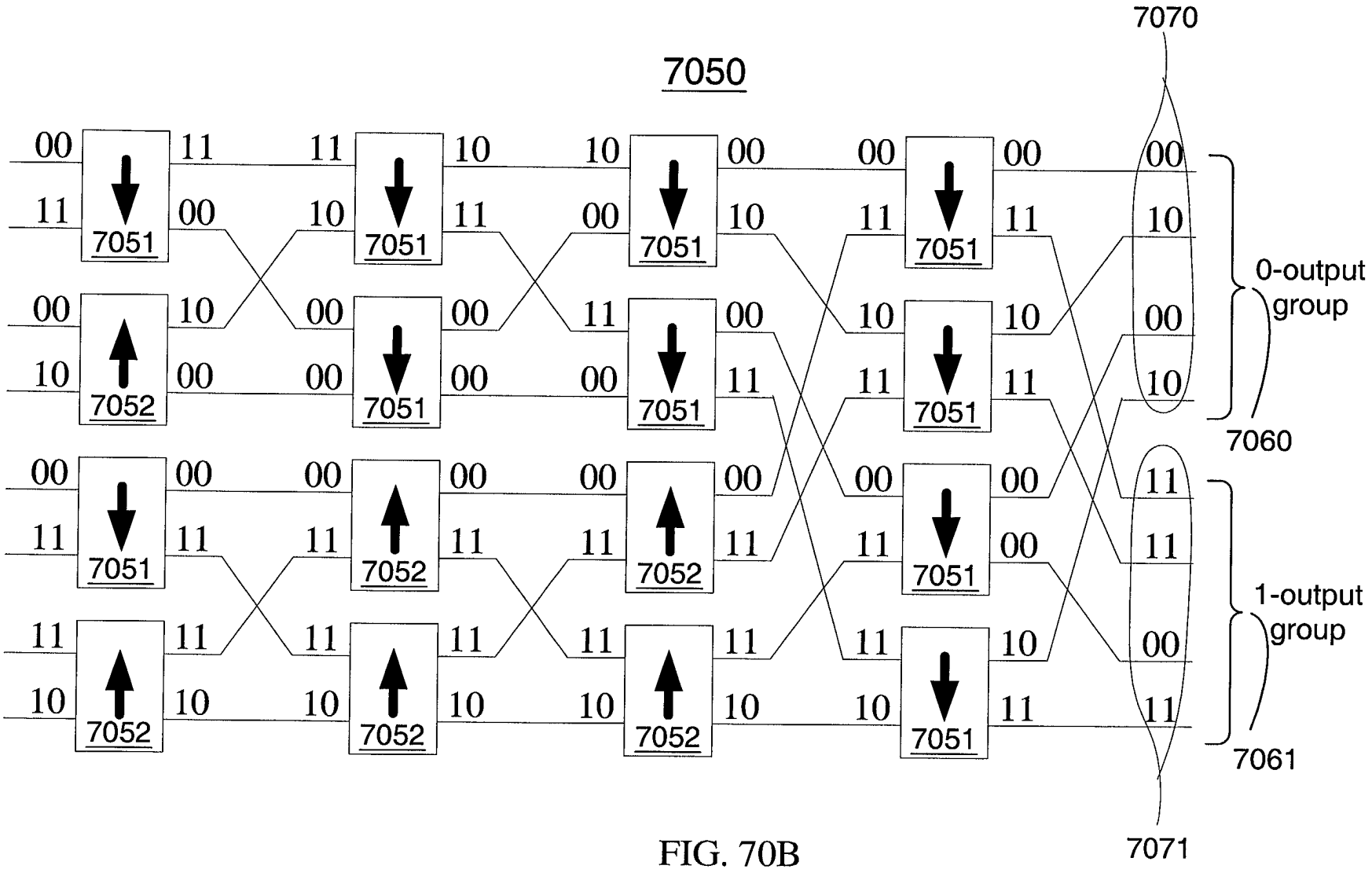


FIG. 70B

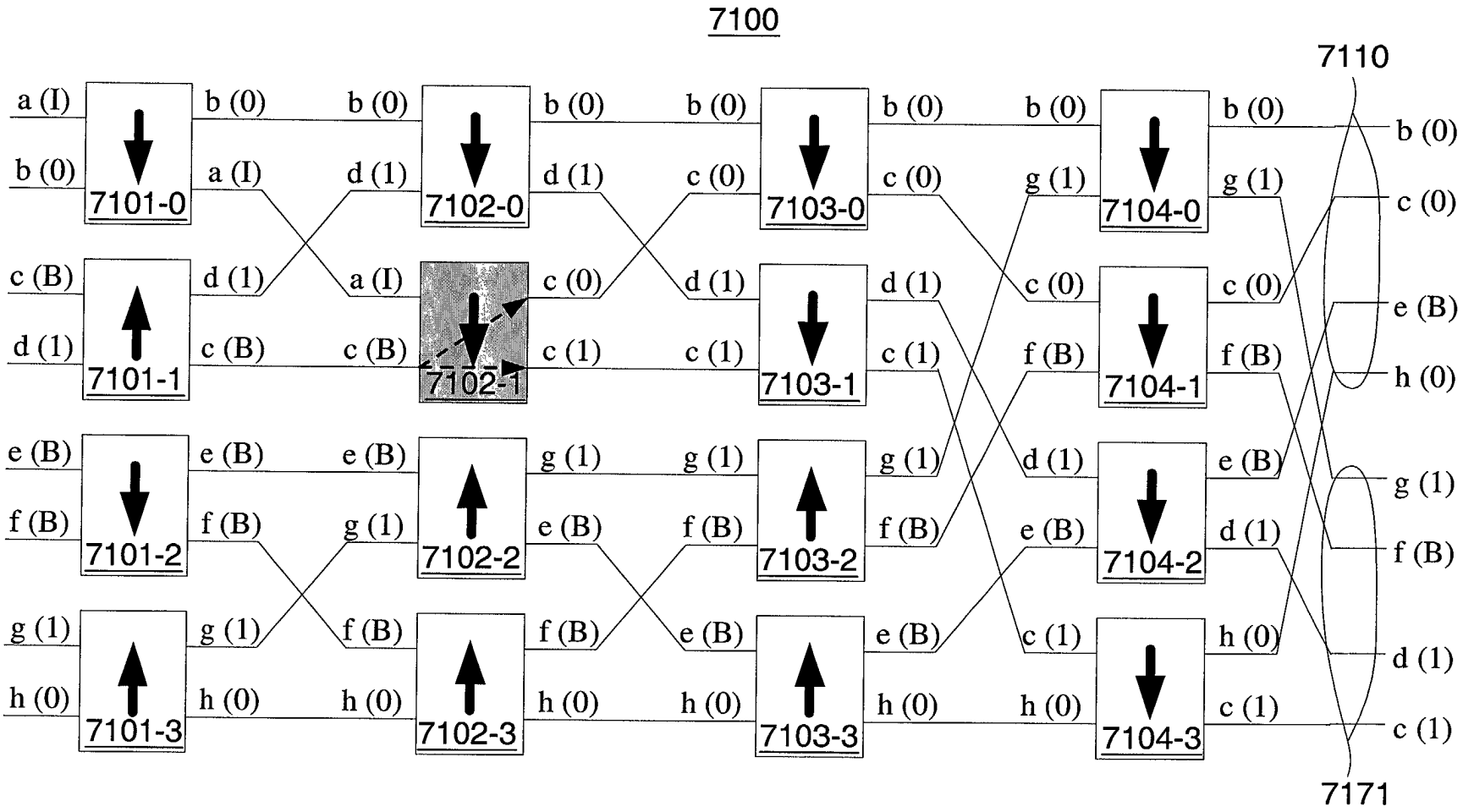

7100
7110
7171
a (I)
b (0)
c (B)
d (1)
e (B)
f (B)
g (1)
h (0)
7101-0
7101-1
7101-2
7101-3
7102-0
7102-1
7102-2
7102-3
7103-0
7103-1
7103-2
7103-3
7104-0
7104-1
7104-2
7104-3

FIG. 71A

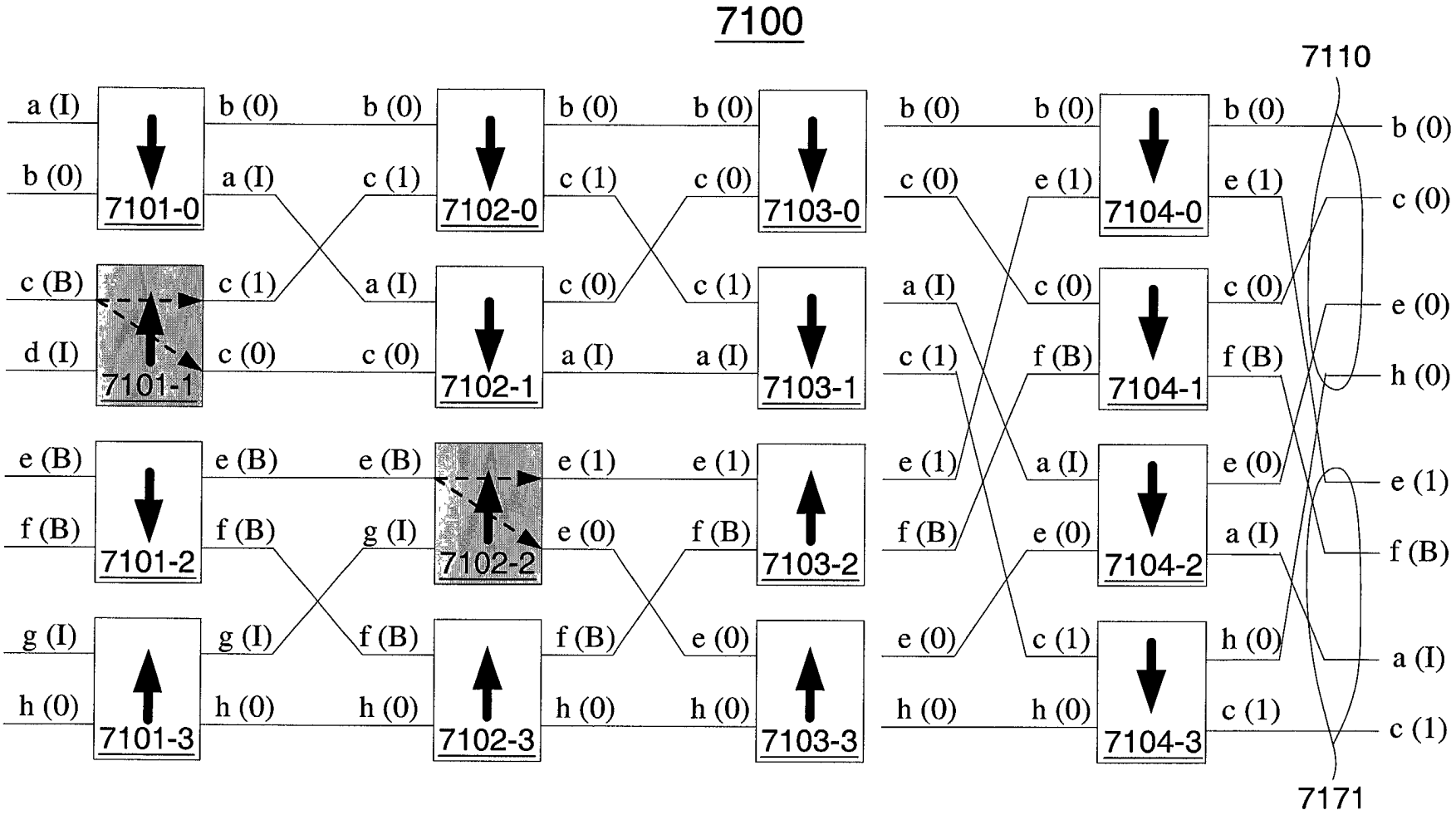

7100
7110
7171
a (I)
b (0)
c (B)
d (I)
e (B)
f (B)
g (I)
h (0)
7101-0
7101-1
7101-2
7101-3
7102-0
7102-1
7102-2
7102-3
7103-0
7103-1
7103-2
7103-3
7104-0
7104-1
7104-2
7104-3
c (1)
c (0)
e (1)
e (0)

FIG. 71B

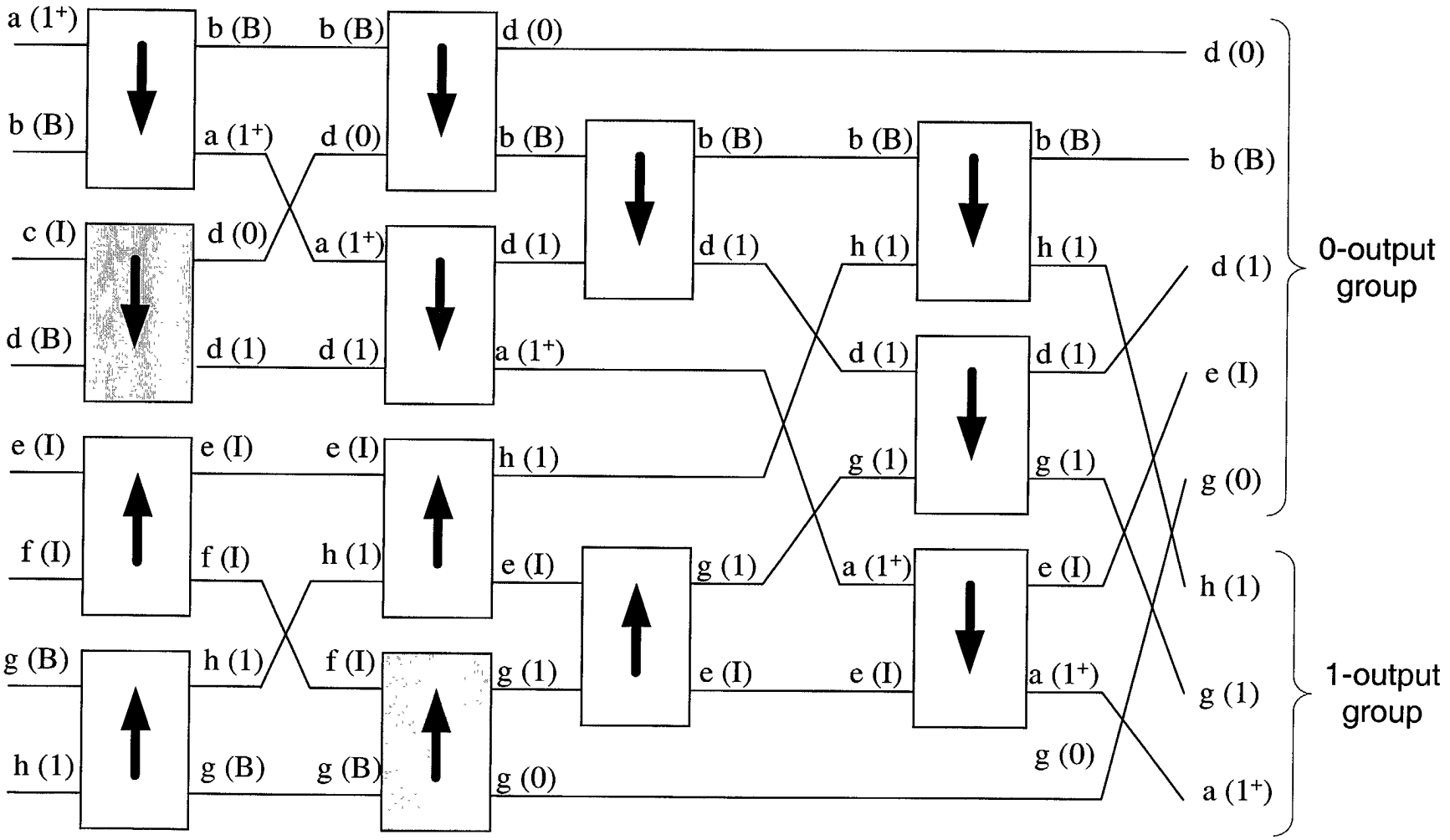

a (1+)
b (B)
c (I)
d (B)
e (I)
f (I)
g (B)
h (1)
b (B)
a (1+)
d (0)
d (1)
e (I)
f (I)
h (1)
g (B)
b (B)
d (0)
a (1+)
d (1)
e (I)
h (1)
f (I)
g (1)
g (B)
g (0)
b (B)
d (1)
a (1+)
e (I)
g (1)
e (I)
g (0)
b (B)
h (1)
d (1)
g (1)
a (1+)
e (I)
a (1+)
g (0)
d (0)
b (B)
d (1)
e (I)
g (0)
h (1)
g (1)
a (1+)
0-output group
1-output group

FIG. 72A

7200

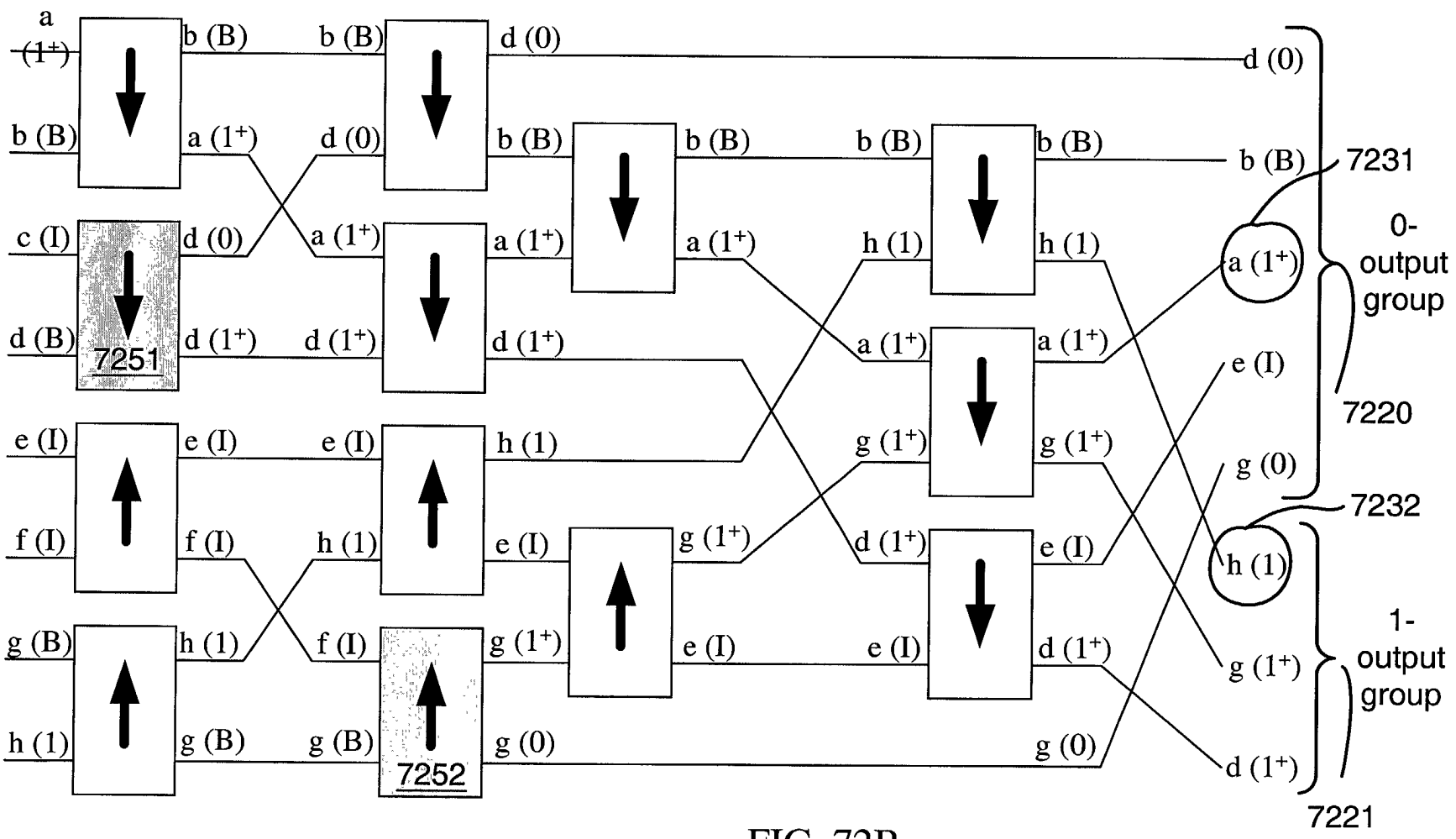

a (1+)
b (B)
c (I)
d (B)
e (I)
f (I)
g (B)
h (1)
7251
7252
7231
0-output group
7220
7232
1-output group
7221

FIG. 72B

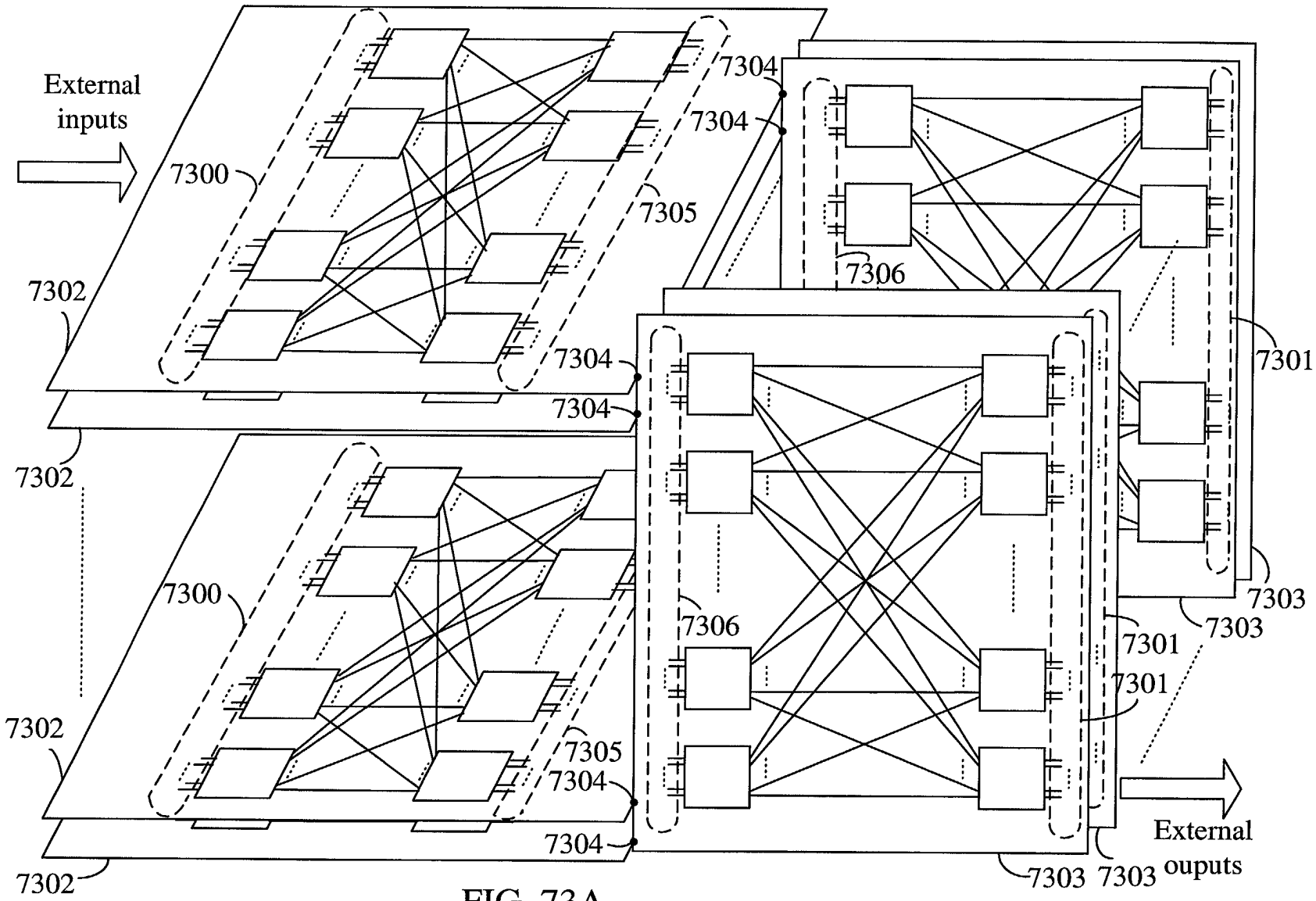
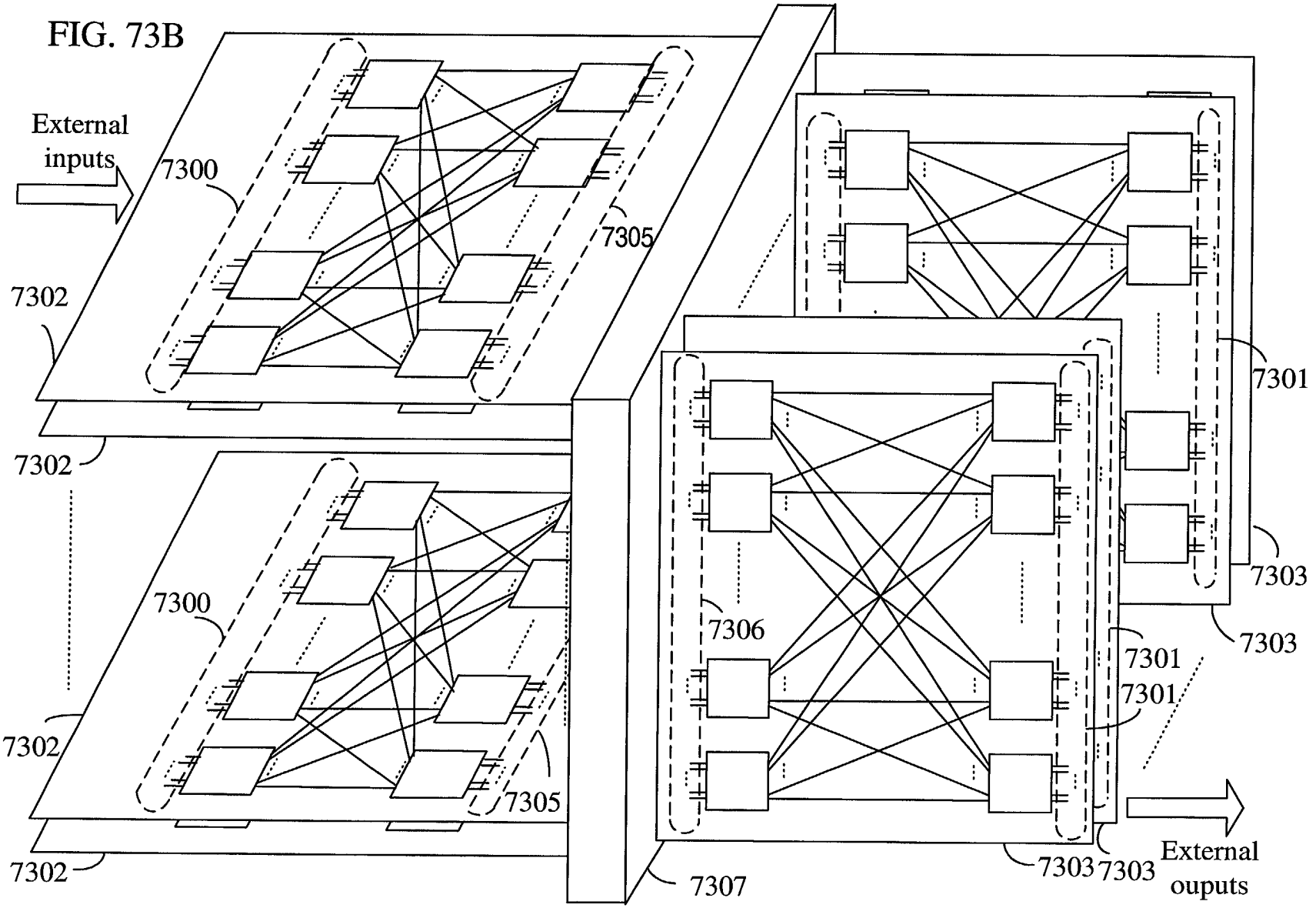

External inputs
7300
7302
7304
7305
7306
7301
7303
External ouputs

FIG. 73A

FIG. 73B


External inputs
7300
7305
7302
7302
7300
7306
7301
7301
7301
7303
7303
7303
7303
7302
7305
7302
7307
External ouputs

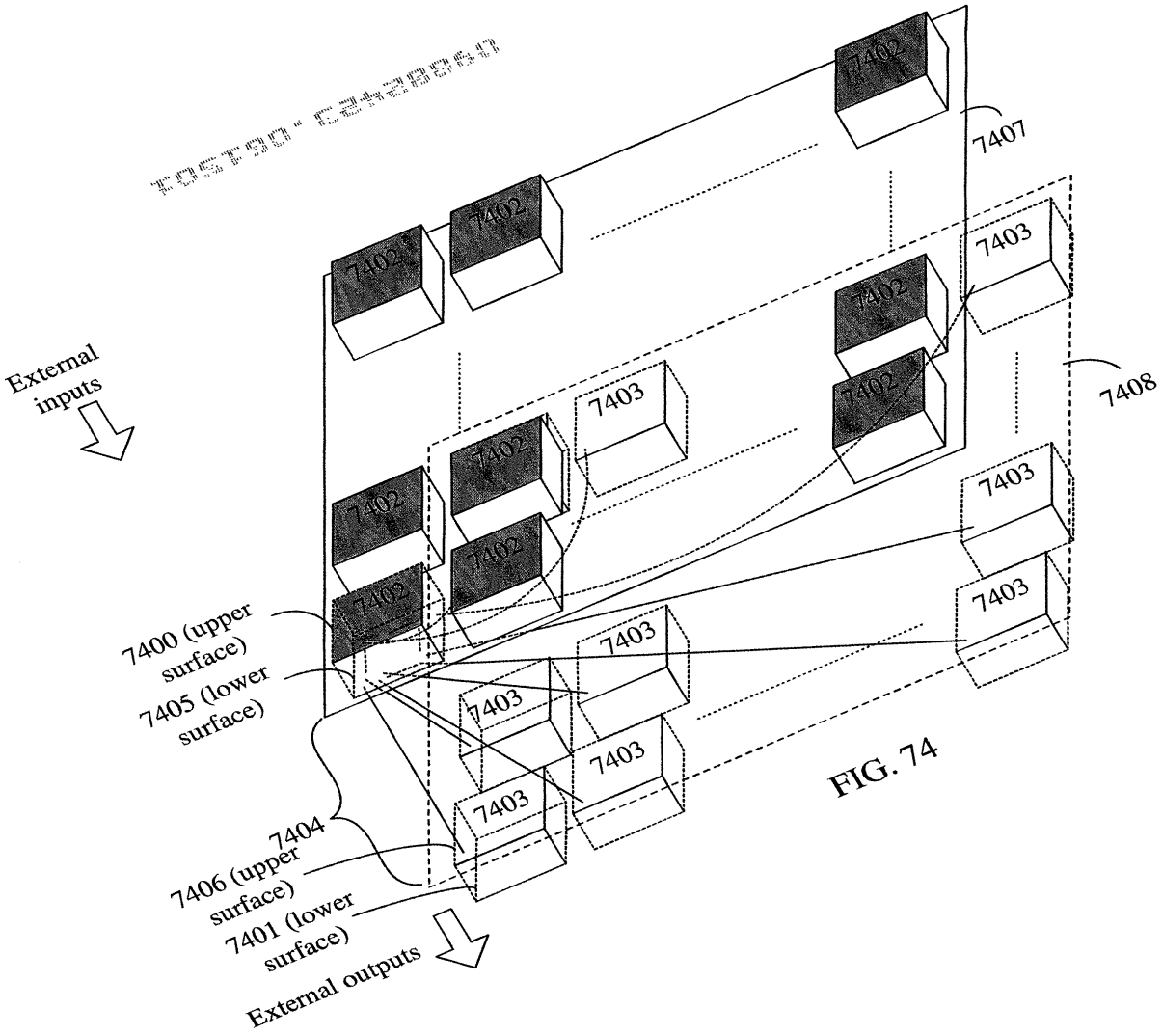

External inputs
7400 (upper surface)
7405 (lower surface)
7404
7406 (upper surface)
7401 (lower surface)
External outputs
7407
7408
7402
7403

FIG. 74

FIG. 75A

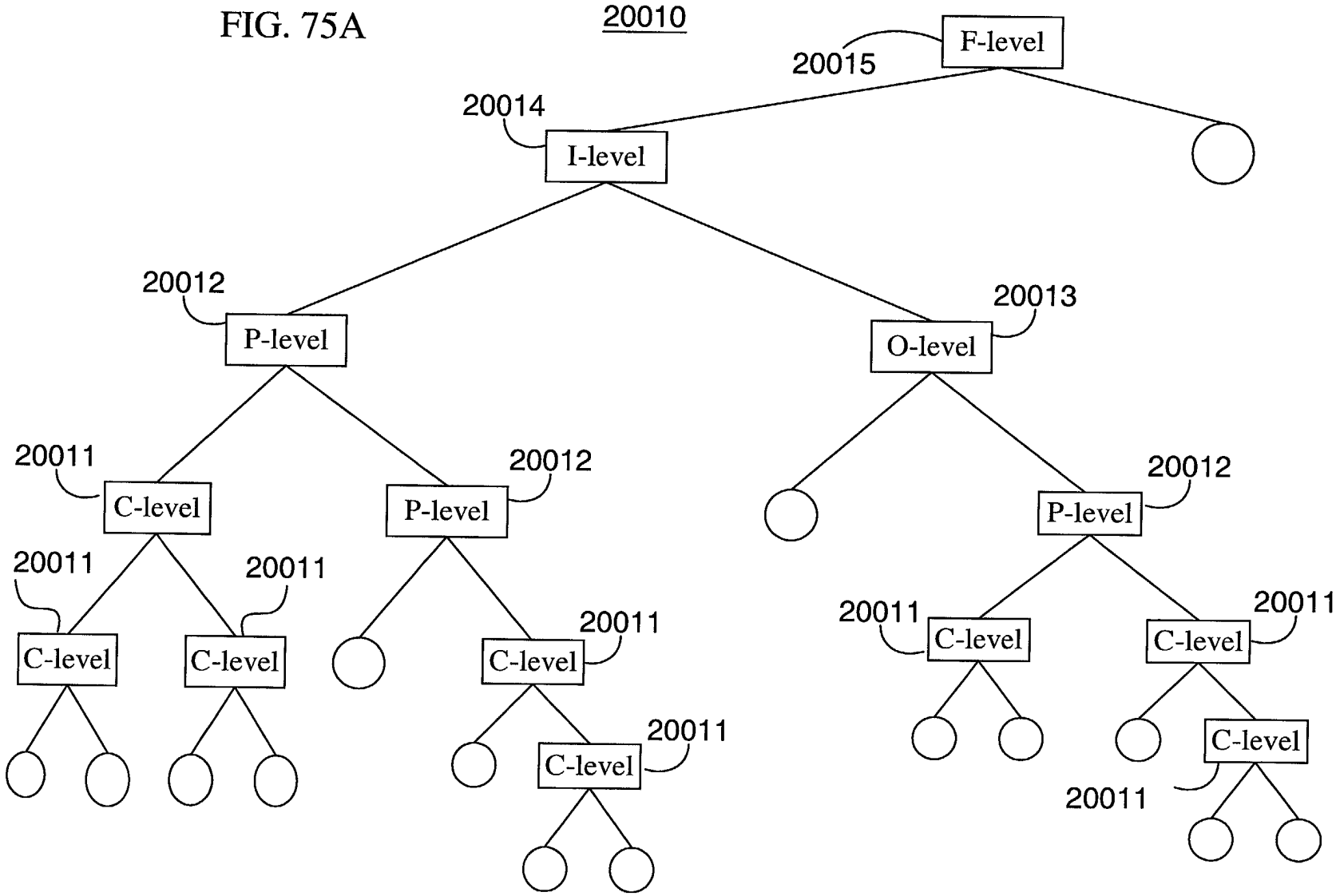
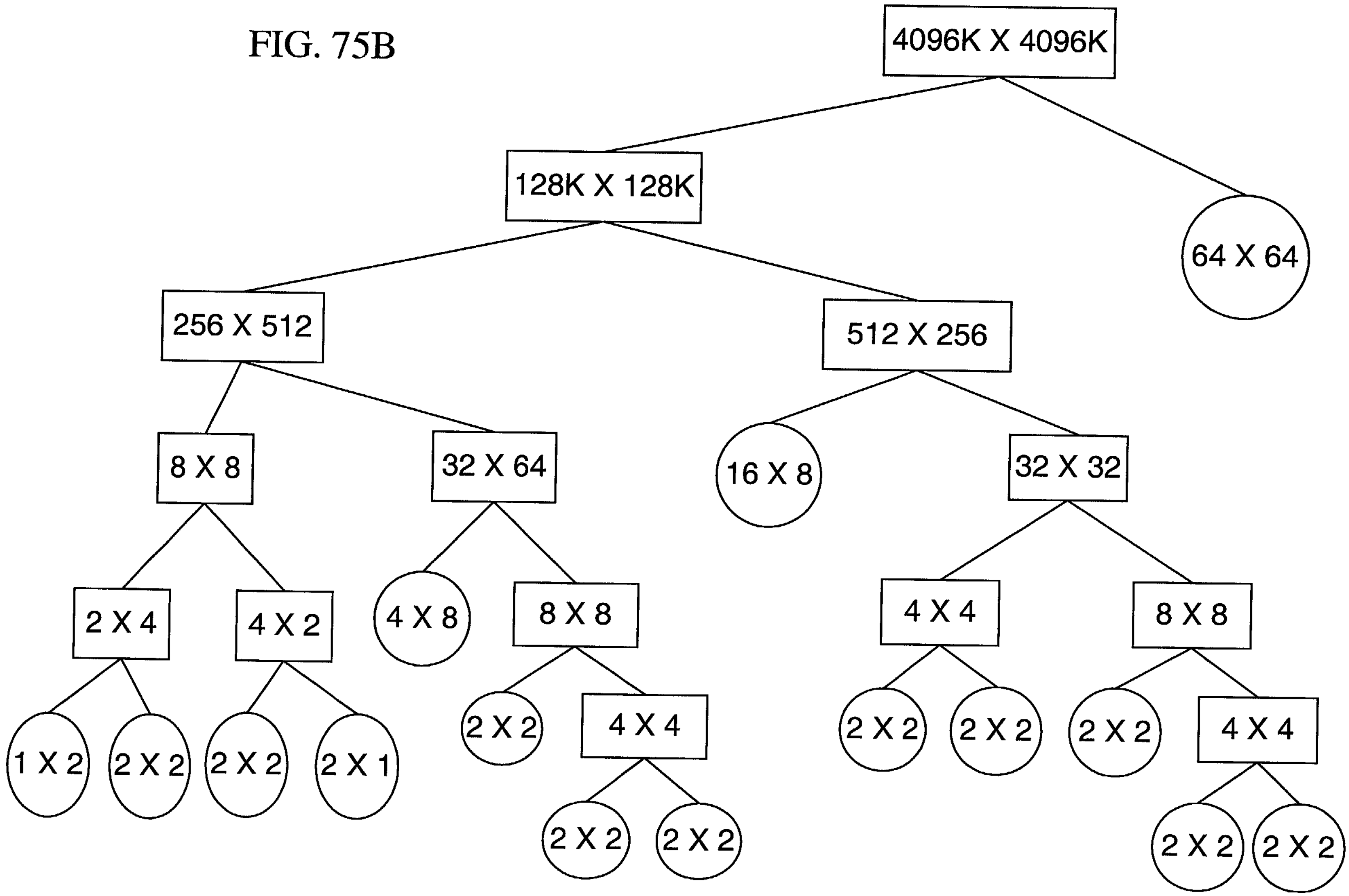


FIG. 75B



4096K X 4096K
128K X 128K
64 X 64
256 X 512
512 X 256
8 X 8
32 X 64
16 X 8
32 X 32
2 X 4
4 X 2
4 X 8
8 X 8
4 X 4
8 X 8
1 X 2
2 X 2
2 X 2
2 X 1
2 X 2
4 X 4
2 X 2
2 X 2
2 X 2
4 X 4
2 X 2
2 X 2
2 X 2
2 X 2

FIG. 75C